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HODGKIN'S DISEASE, WITH BONE AND SKELETAL MUSCLE INVOLVEMENT[1]

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IN 1832 (1) Hodgkin called attention to a group of cases characterized by enlargement of lymph nodes and spleen. In 1856 (2) Wilks recognized the condition as a clinical entity, suggested the name "Hodgkin's disease," and believed it to be allied to tuberculosis. Since that time to the present there has been much investigation and writing in regard to the nature of this disease, the resulting confusion being indicated by the proposed names, *viz.*, pseudoleukemia, lymphoma malignum, lymphadenoma, lymphogranulomatosis, and Hodgkin's disease.

From 1885, the literature records many case reports and varying methods of approach, attempting to ascertain the nature of the process. Sternberg (3) studied thirteen cases of Hodgkin's disease and reported that eight of them presented tuberculosis in one or more organs. His paper has profoundly influenced medical thought in this direction ever since. Andrewes (4), in England, and Reed (5) and Longcope (6), in this country, have done much to clarify the histopathology of the disease, and from their studies they have concluded that it is not due to the tubercle bacillus, though tuberculosis may be associated.

[1]Read before the Radiological Society of North America at the Fifteenth Annual Meeting, at Toronto, Dec. 2–6, 1929.

ETIOLOGY

At the outset it may be well to state that there is no recognized etiological agent. Sternberg (7), in 1925, still adhered to the tuberculous nature of the disease, but many clinical and laboratory studies have not settled this problem either way. The disease is considered neoplastic by some; others state that malignant changes may occur in the diseased tissues, while still others have searched for an infectious agent. Fraenkel and Much (8) reported finding a diphtheroid organism in Hodgkin's nodes. Bunting and Yates (9) isolated and described similar organisms, which, when injected into monkeys, produced lesions similar to those seen in Hodgkin's disease. Bloomfield (10) isolated similar organisms from both normal nodes and nodes from varying pathological processes. Some believe the infectious agent to be a protozoa, others that it is a fungus.

PATHOLOGY

The disease is one of the lymphoid system and may show the predominant lesion in different tissues of the body. The lymph nodes of the body are the structures most frequently involved, but the superficial nodes are not uniformly affected.

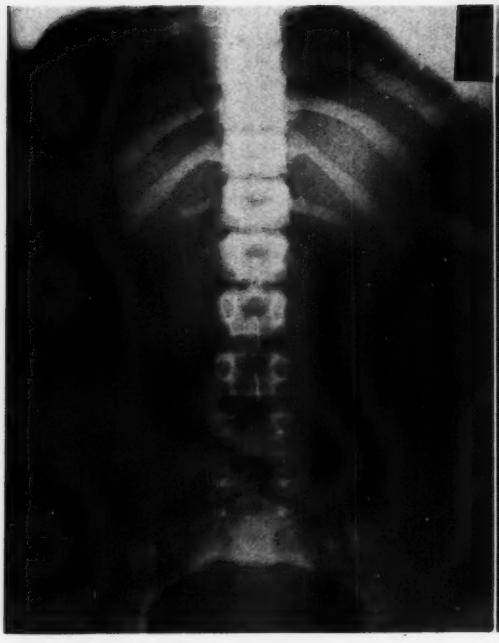

Fig. 1. December, 1927, normal appearance of the lumbar vertebræ.

Fig. 2. October, 1928, destructive changes in the first, third, and fourth lumbar vertebræ.

Symmers (11) divides the lymph nodes into three divisions:

(a) Those of neck, axilla, thorax, abdomen, and groin. It is these which are most commonly affected.

(b) The submucosal group, including the faucial and lingual tonsils, and the lymphoid tissues of the gastro-intestinal, urinary, and respiratory systems.

(c) The auxiliary lymphoid tissues, represented in the walls of the arteries, the spleen and other organs.

Contrary to the usual opinion, Symmers found predominating enlargement of the cervical lymph nodes in but one of his fourteen cases: in four of the cases the cervical nodes were not involved at all. He believes enlargement of the axillary nodes is a sequel to cervical or thoracic involvement, and enlargement of the inguinal nodes to abdominal. In his series the liver was involved in ten of the fourteen cases; enlarged clinically in eight; there was splenic enlargement in nine out of fourteen. In eight of the nine, the picture was typically Hodgkin's; in one there was extensive fibrosis. The bone marrow showed changes in seven. Symmers considers three types of marrow change: *(a)* granulation tissue identical with that in nodes; *(b)* granulation tissue with many thin-walled blood vessels; *(c)* hyperplastic marrow. Skeletal muscle was involved in three cases.

Bone changes have been reported frequently in the literature. Barron (12) noted vertebral involvement in four of twenty-four cases, two of which had deformities suggesting Pott's disease. Montgomery (13), Ginsburg (14), and others report similar cases. Other bones, as the sternum and cranium, may be involved. Lung involvement is not at all rare. Other tissues may also be involved, as the pleura, heart, pericardium, kidneys, adrenals, thy-

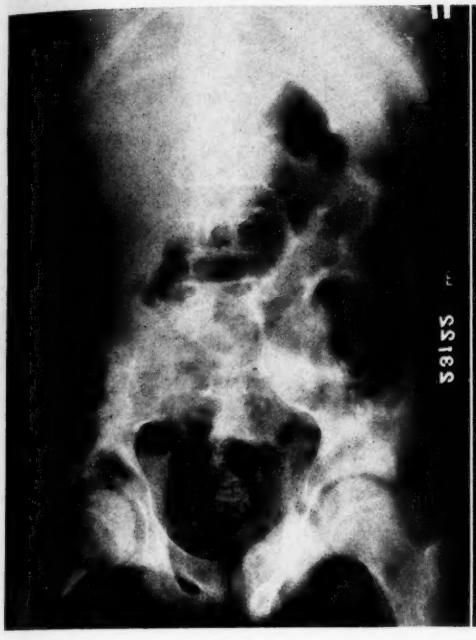

Fig. 3. April, 1929, the destructive involvement is more extensive in all the lumbar vertebræ.

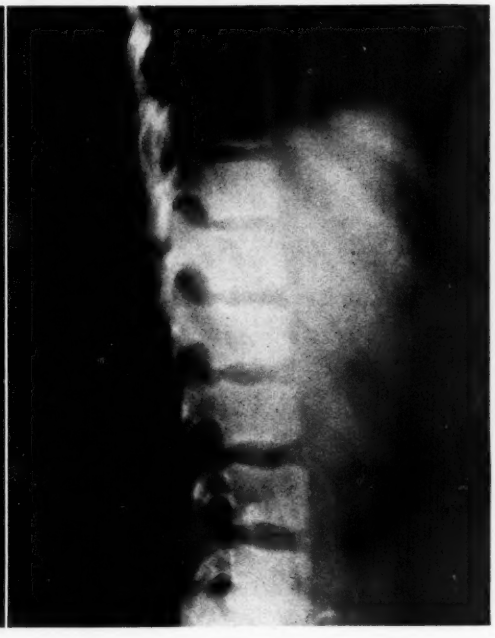

Fig. 4. December, 1927, slight rarefaction of the bodies of the second and third lumbar vertebræ, with an irregular appearance of the surfaces of these vertebræ.

mus, the gastro-intestinal tract, vessel walls, thyroid, testicles, mammary gland, and skin.

The Hodgkin nodule is whitish, frequently with yellowish areas of necrosis. When lymph nodes are involved, the nodes enlarge in chains, the separate nodes adherent but discrete. The cut surface is moist, whitish, and may show areas of yellowish necrosis. Later, there is fibrosis.

Histologically the picture varies with the duration of the disease. Lymphoid hyperplasia, followed by endothelial hyperplasia of the reticulum and of the sinuses, constitutes the earliest changes. Polymorphonuclear and eosinophilic infiltration are common. The giant cells so characteristic of Hodgkin's disease have abundant cytoplasm, one or more large vesicular nuclei, with a prominent nucleolus. In multinucleated cells the nuclei frequently are overriding. In the late stages of the disease the fibrous tissue has largely replaced all other cells, while those remaining are found to be irregularly scattered in the dense fibrous tissue stroma.

CASE REPORTS

L. B., age 15 years, entered the Diagnostic Department of Research Hospital, October 26, 1928, complaining of pain in back and weakness of legs. He stated that in August, 1927, he had bilateral shingles, worse on the left side, appearing in the upper lumbar region, advancing anteriorly to the umbilical region. The lesions remained about two weeks, but pain in the lumbar region has been continuous. In December, 1927, pus cells were reported in his urine. He was cystoscoped and the ureters were catheterized and later treated for pyelitis and stricture of ureter, without im-

Fig. 5. October, 1928, wedge-shaped first lumbar vertebra, rarefaction of the second and third, with loss of the outline of the fourth.

Fig. 6. April, 1929, more marked rarefaction, with the first, third, and fourth lumbar vertebræ almost destroyed, but the discs still intact.

provement. At this time roentgenograms of the chest and lumbar spine were made by Dr. A. D. McGlothian, of St. Joseph, Missouri, to whom we express our appreciation for their use. These showed little change from the normal. The patient's course was downhill, with fever, loss of weight, night sweats, and a continuance of the pain.

Fig. 7. October, 1928, rarefaction of all the pelvic bones, distinct involvement of the head and neck of each femur, with rarefaction of the upper end of each shaft.

On admission his physical examination, except for emaciation and a few enlarged lymph nodes in the right groin, was negative. There was no pus in the urine. Tubercle bacilli were absent. Hemoglobin was 45 per cent; red blood cells 3,540,000; white blood cells 29,000; polymorphonuclears 89 per cent; small lymphocytes 5; large lymphocytes 3; large mononuclears 3. Serology, negative. Roentgenograms of the chest showed increase in size and density of the hilar shadows. The spine showed involvement of the first four lumbar vertebræ: the first was wedge-shaped; in the others there was loss of density and regularity. The roentgenogram of the pelvis showed rarefaction of the pelvic bones and the head and neck of the femurs.

At this time an inguinal node was re-

moved for histological examination. It showed some loss of architecture, fibrous tissue hyperplasia, polymorphonuclear and eosinophilic infiltration, with a scattering of typical Hodgkin's giant cells.

The patient returned to his home the first part of November, 1928, but was readmitted to Research Hospital on December 17, 1928. During his stay in the hospital frequent roentgenograms were made of his spine and chest, all showing a gradual progression of the process described above. He had a constant fever, the peak from 101 to 103 degrees. The leukocytosis was constant, the highest 73,660. He became progressively more anemic, of the chlorotic type. Before death, on May 6, 1929, hemoglobin was 20 per cent; red blood cells 2,540,000, with the cervical and axillary nodes enlarged.

Fig. 8. April, 1929, the same type of destruction is found in the sixth dorsal vertebra.

AUTOPSY

There was approximately 1,000 c.c. of opalescent fluid in the peritoneal cavity, a small amount of clear fluid in each pleural cavity, and a slight increase of the pericardial fluid.

The heart weighed 180 gms., was flabby but otherwise normal. The lungs and hilar nodes together weighed 865 grams. There were whitish nodules of varying size scattered through the lung substance and in the subpleural zones of both lungs, the largest measuring 2.5 cm. in diameter. The hilar nodes were enlarged, firm, with small areas of necrosis; they invaded the lung parenchyma slightly.

Fig. 9. October, 1928, slight hilar gland infiltration.

Fig. 10. April, 1929, extensive hilar gland infiltration.

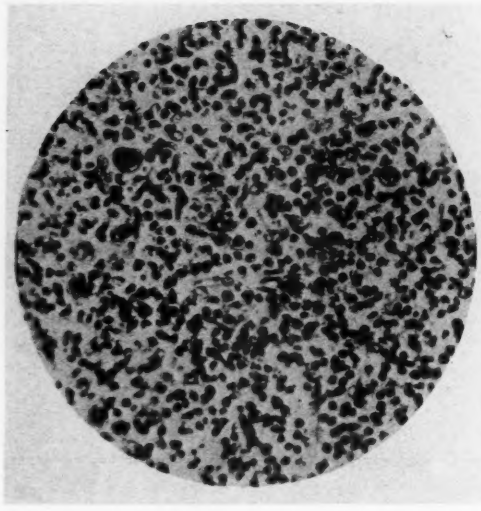

Fig. 11. Lymph node (biopsy); magnification 500 diameters. Leukocytic and eosinophilic infiltration, endothelial hyperplasia and Hodgkin's giant cells.

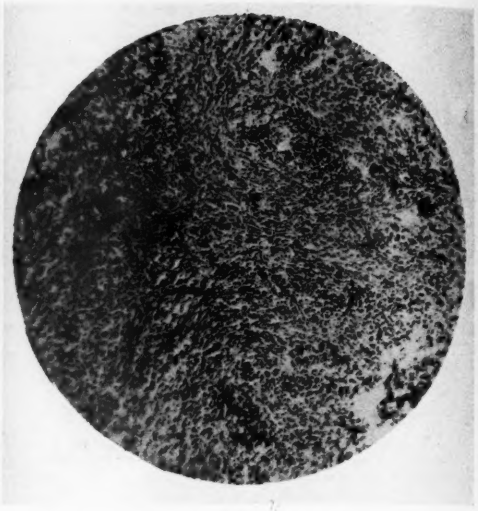

Fig. 12. Lymph node (autopsy); magnification 200 diameters. Marked fibrosis, endothelial hyperplasia, and Hodgkin's giant cells.

The liver weighed 1,660 gms., showed numerous whitish nodules of varying size, the largest measuring 6.5 cm. in diameter, situated at the hilum. The spleen, which weighed 160 gms., showed no nodules or gross changes. The kidneys, urinary bladder, testicles, and gastro-intestinal tract were free of lesions. The celiac, mesenteric, prevertebral, and iliac lymph nodes were greatly enlarged, discrete, but usually adherent

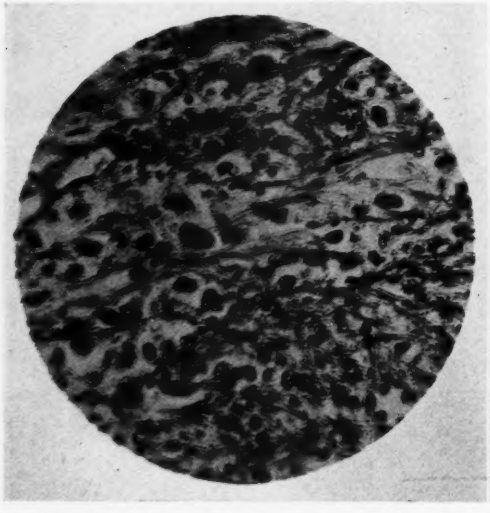

Fig. 13. Lymph node (autopsy); magnification 500 diameters. Marked fibrosis, few polynuclear cells; Hodgkin's giant cells.

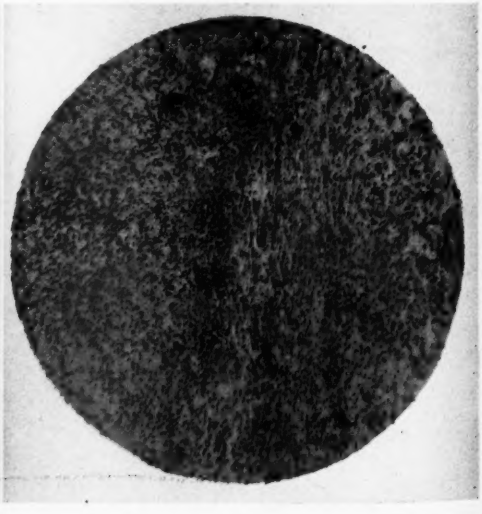

Fig. 14. Liver; magnification 125 diameters. Hodgkin's granuloma; compression of liver cells.

Fig. 15. Hodgkin's granuloma from liver; magnification 500 diameters. Eosinophilic and polynuclear infiltration, fibrous tissue stroma, Hodgkin's giant cells.

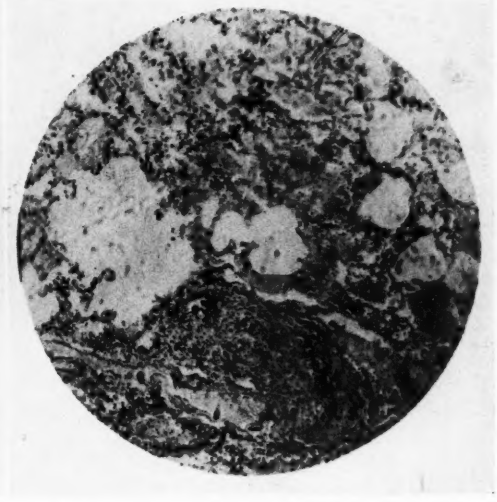

Fig. 16. Lung; magnification 125 diameters. Hodgkin's granuloma; situated about large blood vessel.

through fibrous tissue hyperplasia. On section they showed varying pictures: some were soft, moist, and whitish, with small areas of necrosis, while others were distinctly fibrous.

The left iliopsoas was largely replaced by the same type of tissue that was noted as infiltrating the lungs and liver.

The vertebral bodies of the lumbar vertebræ were soft and easily cut with a large knife. The bone was replaced by a yellowish white, soft tissue, which showed small areas of yellowish mucoid material. The pelvic bones, so far as they could be examined, showed the same softening and replacement.

Histologically, sections from the lymph nodes, the nodules in the lungs, the liver, and the psoas muscle showed the same general picture but differed in detail, such changes consisting of fibrous tissue proliferation of varying degrees, with giant cells of the Hodgkin type, polynuclear and eosinophilic infiltration, and varying degrees of necrosis. The spleen showed no granulomatous areas, but a few giant cells of the Langhans type were present, the nuclei of these containing nucleoli. The bone sections showed few bone trabeculæ, those present being quite regular in their outline; osteoclasts were not seen. The marrow contained practically no fat; there was a fibrous tissue reticulum with mononuclear cells and giant cells of the Reed type. Megalokaryocytes or myelocytes were not seen; there were, however, plasm cells and lymphocytes.

SUMMARY

A case of Hodgkin's disease is presented, in a boy of fifteen, whose first symptom was shingles and whose presenting symptom on admission was backache. At this time a roentgenogram revealed definite bone destruction in the first four lumbar vertebræ, the ilium, and the femurs, although six months previously there had been no definite changes in these structures. Biopsy established the diagnosis of Hodgkin's disease. The course was one of increasing severity, with bone destruction of the dorsal and lumbar vertebræ, ilium, and femurs, and in-

Fig. 17. Specimen from vertebral body; magnification 80 diameters. Few bone trabeculæ, smooth outline, absence of osteoclasts, bone lacunæ and bone cells present, absence of fat in marrow, loose fibrous tissue stroma.

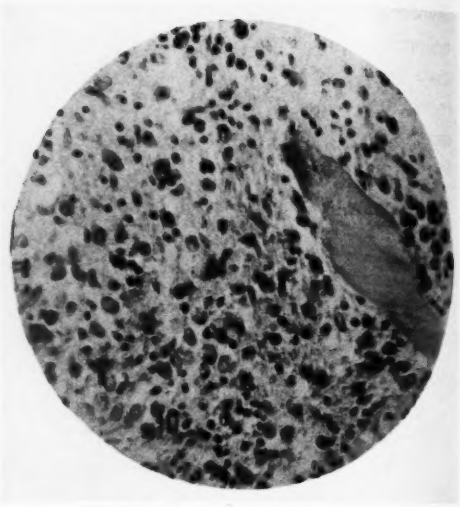

Fig. 18. Vertebral body; magnification 250 diameters. Absence of fat, scattering of lymphocytes, monocytes and Hodgkin's giant cells.

volvement of all lymph nodes, lungs, liver, and skeletal muscles.

CONCLUSIONS

(1) Shingles has too frequently been reported in Hodgkin's disease to be without significance.

(2) Hodgkin's disease frequently produces widespread bone destruction, the vertebræ perhaps being the bones most frequently attacked. Hodgkin's disease must be considered in cases presenting vertebral destruction.

(3) Skeletal muscle is not infrequently invaded in this disease.

We express our indebtedness to Dr. Paul Hemphill for notes on this case and to Dr. Mortimer Cohen for assistance in preparation of slides.

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DISCUSSION

Dr. A. U. Desjardins (Rochester, Minn.): The case reported by Dr. Lockwood is of extreme interest, because I have never seen such a case as this and do not recall any being previously reported. Bone

involvement in lymphoblastoma is not as uncommon as is generally supposed, and may be of two varieties: direct involvement of the bone marrow itself, or indirect involvement through pressure of enlarged lymph nodes. In some cases it is very difficult to be certain just which variety of involvement is present in a particular case, and only by prolonged observation can one make up one's mind about it. In any case of Hodgkin's disease or lymphosarcoma, where pain is a sufficiently prominent feature to attract attention, bone involvement must always be suspected; pain in lymphoblastoma is a common indication of bone involvement or infiltration of other structures, such as a bronchus, the renal pelvis, etc.

SAFEGUARDING THE STORAGE OF PHOTOGRAPHIC, MOTION PICTURE, AND X-RAY FILMS[1]

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THIS paper outlines briefly the hazards connected with the storage of photographic, motion picture, and X-ray film of the nitrocellulose variety, and suggests precautionary measures to be taken with these materials. The various kinds of film are described and the effect of heat is discussed, with particular reference to the toxicity and explosibility of the gases developed. Recommendations for proper storage and handling are made, including suggestions for location and construction of the vaults which should be used where any considerable quantity of film is to be stored.

DESCRIPTION OF FILM

Photographic film consists of a base or support on which is coated a light-sensitive emulsion. This emulsion is a gelatin solution containing very small crystals of silver halide (usually the bromide with a small percentage of iodide), which are formed in the gelatin solution by the reaction of silver nitrate with potassium bromide and iodide. Potassium nitrate, also formed in this reaction, is removed from the emulsion before coating. Photographic processes following exposure in the camera convert the silver halide which has been affected by exposure to light to metallic silver in a very finely divided state and also remove all of the unused silver halide. The metallic silver image is all that remains in the gelatin after this process is completed. For the base either of two materials is used, a solid solution in camphor of nitrocellulose, which is highly flammable and gives off toxic gases on decomposition, or cellulose acetate, which has a flammability comparable to that of ordinary paper. Film made from cellulose acetate is called "safety film" and is not particularly hazardous in storage. Its use wherever possible is, therefore, to be highly recommended.

Films for various uses differ in size, thickness, and amount of emulsion. Photographic film for amateur use is generally thin, small in size with a thin coat of emulsion on one side, and with or without gelatin on the other. Most large commercial photographic film is heavier and coated on both sides, to prevent curling. Motion picture film is generally of the same thickness (about .006 inch) and, except for some of the color films, is coated on one side only. Except for dental films, which are small, thin, and usually mounted, X-ray films are relatively thick and have heavy coats of emulsion on both sides. The latter may be as much as 10 per cent of the thickness of the film. The largest size of film generally used in X-ray work is about 14 by 17 inches and .008 inch or more in thickness.

EFFECTS OF HEAT

Nitrocellulose, which forms the base of "nitrate" films, is a substance prepared by treating cellulose made from cotton with sulfuric and nitric acids. It is thus essentially similar to celluloid and guncotton, being intermediate between these two in nitrogen content. The burning characteristics of all three materials are similar, differing only in degree. It should be noted, however, that the burning characteristics of film may be altered somewhat both by the presence of the emulsion and conditions of storage.

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[1]Publication approved by the Director of the Bureau of Standards of the U. S. Department of Commerce.

Reprinted by permission from *Safety Engineering*, August, 1929, LVIII, 56.

This is particularly true of film, such as X-ray film, coated on both sides and stored in envelopes.

When subjected to temperatures somewhat above 100° C. (212° F.) nitrocellulose materials decompose at a significant rate even in the absence of air. This decomposition is exothermic, that is, it gives off heat, and for this reason can raise the material up to its ignition point under favorable conditions. The rate of decomposition increases rapidly with increase in temperature and may become explosive in character. In the case of celluloid heated to 120° C. (248° F.), rapid decomposition has been observed after eight hours of heating.[2] At 135° C. (275° F.) about four hours were required, while at 170° C. (338° F.) less than three minutes were required to obtain decomposition leading to ignition and in many cases actual explosion.[2] Motion picture film will ignite within one minute at about 165° C. (329° F.). Recent tests on double coated X-ray film show that while no indication of decomposition could be obtained within four hours at 120° C. (248° F.), decomposition was started in a similar sample, which was being heated slowly, when the temperature reached 133° C. (271° F.). Within seven minutes the temperature had reached about 155° C. (311° F.), at which temperature the decomposition became very rapid. Other tests showed that decomposition could be started within 1½ minutes at 170° C. (338° F.). No flaming nor explosion of this film was obtained in these tests. The fact that X-ray film is slightly harder to ignite than motion picture film under similar conditions must be attributed to the protection afforded by the coating of emulsion on both sides of the former.

The relatively low temperature at which decomposition can start in these materials makes it necessary to eliminate sources of heat not usually considered dangerous. Experiments have shown that lighted electric lamps of the 60 and 100 watt sizes can start decomposition within 32 and 9 minutes, respectively, when in contact with envelopes containing X-ray film. The ignition of motion picture film by the heat from a projection lamp is a common occurrence. Steam pipes or coils containing steam at moderate pressures could also be means of starting decomposition of film stored in contact with the pipes. Glowing cigarette stubs are sufficient to cause ignition, and, of course, even momentary contact with any flame will ignite any nitrocellulose films.

After decomposition has started in film coated on one side only, such as motion picture film, the reaction proceeds rapidly with the evolution of heat, and flaming soon results. If the material is confined, an explosion may occur in the gases developed on being mixed with air. On the other hand, the decomposition of X-ray film proceeds more slowly due to the protection given by the coating, and actual ignition is more difficult to obtain. The heat of the reaction can cause glowing in paper envelopes, however, and these will burst into flame if sufficient air is present. Moreover, as in the case of motion picture film, some of the gases developed are highly flammable and will ignite upon coming in contact with flame if mixed with a sufficient quantity of air.

It is interesting to compare the rate of burning of X-ray and motion picture film with that of paper of the same size. X-ray film with the coating removed from one or both sides and ignited with a match will burn about two or three times as fast and with a larger flame than the film with emulsion on both sides. The latter, in turn, burns about two or three times as fast as manila paper of the same size and thickness. Motion picture film of the same length, but half as wide and three-fourths as thick.

[2] Stokes and Weber: Effects of Heat on Celluloid and Similar Materials. Bureau of Standards Tech. Paper No. 98, Oct. 15, 1917.

burns about twice as fast as the double coated X-ray film.

The decomposition products of these films vary in character and quantity according to the nature of the film and the conditions of storage. In addition to camphor vapor, the following gases have been identified in the decomposition products of ordinary celluloid[8]: oxides of nitrogen (NO, NO_2, and N_2O_4); carbon monoxide (CO), carbon dioxide (CO_2), nitrogen (N_2), methane (CH_4), and hydrogen (H_2). These oxides of nitrogen and carbon monoxide are extremely poisonous and are likely to be formed in large quantities if the air supply is limited, such as in the case of double-coated films closely packed in envelopes. Other things being equal, it appears probable that X-ray and large photographic films will produce greater quantities of these gases on decomposition than motion picture film. Carbon monoxide is a colorless, odorless gas, but the oxides of nitrogen (NO_2 and N_2O_4) can be detected by the deep brown color, and they are formed immediately when nitric oxide itself (NO) comes in contact with the air. Moreover, carbon monoxide, hydrogen, and methane all form explosive mixtures with air, which will ignite upon contact with a flame. All of these gases except the oxides of nitrogen are lighter than air at ordinary temperatures and tend to rise above the surrounding atmosphere. Unless heated to high enough temperatures, the oxides of nitrogen tend to fall to the ground. These points must be kept in mind in making regulations for storage of film.

REQUIREMENTS FOR STORAGE

The proper methods to be used in storage of nitrocellulose film depend upon the nature and quantity of the material and upon the occupancy of the building in which the films are used. For example, the requirements for small mounted dental X-ray films do not have to be so rigid as those for large X-ray film for hospital use, or for motion picture film. Also greater precautions should be taken in storing films in hospitals, clinics, and in large office buildings than for storage in small isolated buildings where the danger to life is not so great. Of course, large quantities of any kind of nitrocellulose film require particular care in storage.

The use of fire-resistive, sprinklered, and vented cabinets and vaults is to be recommended for the storage of all nitrate film except in very small quantities. The construction and use of vaults will be discussed more fully later. Cabinets are to be of metal throughout, with tight fitting doors. Storage compartments should have vertical separations between them and units should not be too large. Films should not be packed tightly and should be removed and destroyed as soon as they are no longer useful for record purposes. Cabinets should never be left open and should be so located as to require a minimum amount of artificial light. No extension cords or other than rigid light fixtures should be permitted in the room. Smoking and the carrying of any open flames into the room should be rigidly prohibited. The cabinets should not be used for storage of materials other than films and should not be located near any source of heat.

Fire-resisting vents for both cabinets and vaults are to be of sufficient size for the amount of films stored, should lead directly to the highest part of the building, and should be open to the outside air. All vent ducts should be unobstructed and should not be adjacent to chimneys nor other sources of heat. The opening to the air should be located as far away as possible from the walls of other buildings in order to minimize danger to life and also to prevent adverse wind pressures into the vent.

[8]Bureau of Standards Technical Paper No. 98.

At least one vent should lead from each enclosed unit of storage.

Automatic sprinklers of standard approved make and installation should be located in both vaults and cabinets. At least twice the number recommended for ordinary occupancies are recommended for film storage in order to provide an adequate supply of water in case of fire. One or more sprinkler heads should be so placed in each cabinet unit as to be effective over the entire space. The number of sprinklers required for a vault depends upon the size of the vault, but should be properly located. Sprinkler heads should be designed to burst at temperatures between 135° and 155° F. Frequent inspection of the entire sprinkler system is recommended.

While the maximum quantities of film which can be permitted in storage depend upon the nature of the film, the occupancy of the building, and the type of storage available, as well as local conditions, the following figures can be given as representative: Where no protection in storage is available, not more than 25 pounds of photographic or X-ray film, nor more than 5 standard reels of motion picture film should be permitted. For storage in vented and sprinklered cabinets, up to 1,000 pounds (or 200 reels) may be kept, but not more than 100 pounds (20 reels) should be stored in each cabinet unit. For vaults, a maximum of 5,000 pounds (1,000 reels) can be allowed in each vault, which should not exceed 750 cubic feet in total storage capacity including aisles. It should be noted that these are minimum requirements based somewhat on existing regulations. The requirements for hospitals, clinics, and similar institutions should preferably be more rigid, particularly where no vault is provided. The size of the vent should be in proportion to the capacity of the storage facilities. For motion picture films, a minimum of 1 square foot of cross-sectional area for each 100 reels is recommended. For each 1,000 pounds of X-ray film, at least 4 square feet should be provided.

VAULT CONSTRUCTION

Vaults for film storage should preferably be located on the roofs of buildings, provided they can be supported on fire-resistive members from the ground up. Where located within buildings, the strength and fire-resistance of the vault and vent structure should be such as to confine the fire and fumes entirely within them. Location of vaults in a separate building at a suitable distance from other major buildings is preferable, where ground space and use-considerations permit. If placed on the roof, the vault should be located on an outside wall or corner, away from higher adjacent buildings. As in the case of vents, it should not be close to chimneys, steam piping, or other sources of heat.

Walls or partitions, floors and ceilings should be of fire-resistive construction and should be strong enough to resist moderate pressures from within the vault. Walls should be continuous from floor to ceiling and should be anchored. The walls of vault and vent, as well as floor constructions above and below, should have a minimum fire-resistance of three hours as gauged by the standard testing procedure. The constructions as well as the doors should be designed to resist outward pressure of not less than 200 pounds per square foot, with the factors of safety generally used for structural work.

Openings, such as windows and skylights, except for entrance and vent, should not be permitted. Doors should not be placed between adjacent vaults. The entrance to the vault should consist of a self-closing metal or metal-clad smoke-tight fire door, with an additional closing device actuated by a fusible link. A better arrangement would be to

have a small vestibule between the vault proper and the fire door, with doors swinging outward between the vestibule and the vault. The fire doors should also open outward.

As stated above, all vaults should be provided with adequate sprinklers and vents. Storage should be made in metal shelving or cabinets. Motion picture film should be kept in metal containers and it is preferable to have metal doors in front of shelving used for photographic or X-ray film storage. All shelving should be open from top to bottom to permit access of water from sprinklers overhead, but insulated vertical separations should be placed at intervals along the shelves. Storage should not be permitted to heights greater than three-fourths the height of the room.

The room temperature should be kept as low as consistent with the comfort of attendants and the prevention of freezing of sprinkler pipes. While there is available no evidence of spontaneous heating or decomposition of film at temperatures much below 100° C. (212° F.), low temperature prolongs the life of the film. All radiators or other means of heating should be well protected to minimize the hazard to the film storage.

Only fixed metal-encased vapor-proof globes should be used for lighting. These are to be placed at the ceiling and a small "pilot light" should be located outside the vault. No provisions should be made for the use of extension cords and the latter should be absolutely prohibited. Wiring should conform to approved safety practices and light switches should be located outside the vault. The precautions in storage already given for cabinets, apply equally to vaults.

HANDLING OF FILM

In addition to the storage of nitrocellulose film, its handling also presents special hazards which may be considered at this point, particularly with regard to photographic and X-ray film. The precautions to be taken in the handling and projection of motion picture film have been covered quite fully by various authors and need not be discussed here. In the use of photographic and X-ray film, different processes, such as photography, developing, and drying, should be done in separate rooms, each provided with fire doors and sprinklers. The quantity of unexposed film should be kept down to the minimum required for current use. Similarly, films in process of development should not be allowed to accumulate and should be consigned to storage as soon as possible. The use of flames and unnecessary sources of heat should be avoided and guarded against.

Finally, the handling of all nitrocellulose film should be done only by a trained personnel, who understand thoroughly the hazards involved and are willing to take all precautions to prevent fire. No others should be allowed to handle this film, particularly in storage rooms, where the hazard is greater because of the large quantities present.

SUMMARY

The storage of nitrocellulose film, whether photographic, motion picture, or X-ray, has been shown to be extremely hazardous. Decomposition, which is exothermal, is started at slightly elevated temperatures and large quantities of highly poisonous and explosive gases are produced. Moreover, the film burns very rapidly and can not be extinguished readily except by an abundant supply of water. Recommendations for storage have been made which include the use of vented and sprinklered cabinets and vaults of fire-resistive construction, and the avoidance of all sources of heat which might start decomposition or ignite the film. Handling of film should be done by a

trained personnel who recognize the hazards involved.

In conclusion, in view of these hazards to both life and property, it appears proper to discuss the characteristics of cellulose acetate film. This material, called "slow-burning film," is much more difficult to ignite than nitrate film, burns at a much slower rate, and does not tend to give off toxic gases on burning. Moreover, it is not subject to an exothermal decomposition at moderate temperatures. As stated previously, its flammability is comparable to that of ordinary paper. While some objections have been made to its use from the photographic standpoint, these appear to have been met in part by improvements in manufacture. Despite its slightly greater initial cost, therefore, the reduced cost of safe storage and elimination of the hazards would seem to justify a more general use of cellulose acetate film.

FACTORS OF ERROR IN THE ROENTGENOLOGIC DIAGNOSIS OF DISEASES OF THE COLON[1]

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THE problems involved in the diagnosis of diseases of the gastro-intestinal tract have yielded in a remarkable manner to the roentgenologic method. The accuracy and constancy of the findings in the presence of organic disease have made the method so reliable that when errors are made they are ascribed less to imperfection or inadequacy of the method than to lack of acuity or experience on the part of the observer or to his failure to elicit the complex of pathognomonic signs. Added to human error on the part of the roentgenologist is the same factor on the part of the surgeon or pathologist on whose observations we are obliged to depend for corroboration or contradiction of roentgenologic opinions. Certainly the roentgenologic method is not above criticism in other respects, but its competency in the field of gastro-intestinal diagnosis can scarcely be overestimated.

In particular are these statements true with respect to diagnosis of diseases of the esophagus, stomach, and duodenum. The relatively simple anatomic structure and arrangement of these organs, their accessibility to visualization, palpation, and manipulation, the ease with which they are satisfactorily prepared for examination, and the sustained interest in their investigation because of the high incidence of demonstrable disease in them, all have been factors responsible for the attainment of the high degree of precision presently accorded to the roentgenologic method. The small intestine, although accessible to palpatory manipulation, has a most complex anatomic arrangement, and, if the signs of acute or subacute obstruction are excepted, the roentgenologic method has done little to clarify the diagnostic problem. However, roentgenologic investigation of the terminal segments of the ileum and of the colon, although they are of more complex anatomic arrangement than the stomach and duodenum, has given most gratifying results. By painstaking application of the method, it is possible to demonstrate organic disease and to establish the correct differential diagnosis with precision closely approaching that attained by its application to the esophagus, stomach, and duodenum. Because of the high efficiency of the proctologic method in the diagnosis of diseases of the rectum and distal part of the sigmoid colon, the roentgenologist, as a rule, has little of import to add to the data it yields.

The opaque enema has remained the procedure of choice in the roentgenologic investigation of the colon. The material should be uniformly suspended and the suspension well sustained. For this purpose one of several commercial preparations may be used, or the opaque salt may be suspended in a mixture of mucilage of acacia, condensed milk, and water. Its consistence should be that of heavy cream. It is most important that the enema be kept at or slightly above the temperature of the body, because the colon reacts violently at times to application of cold. With the patient in the recumbent position, the colon is filled slowly and steadily by the gravity method and the progress of the opaque material is observed roentgenoscopically. An effort is always made to fill the colon completely and to visualize the terminal segments of the ileum.

[1]Read before the Radiological Society of North America at Toronto, Ontario, Canada, Dec. 2–6, 1929.

Fig. 1. Localized chronic ulcerative colitis of the transverse colon. Ileocolostomy had been done elsewhere for supposed carcinoma.

Fig. 2. Filling defect of the transverse colon near the hepatic flexure. Extensive carcinoma of the gall bladder and the head of the pancreas was found at operation.

Unless the appendix has been identified definitely, the point of entrance of the ileum is a valuable landmark to indicate that the entire cecum has been filled.

Preparation of the colon for examination is important. Thorough removal of all fecal remnants, gas, and fluid from the lumen of the colon is essential for a satisfactory estimate of the integrity of the organ; saline purgatives are therefore contra-indicated. Purgatives, the action of which depends on their property of activating the bowel by irritation, are likewise undesirable, because they are not uniformly efficient and because they tend to leave the colon in such an irritable state that retention of the enema becomes extremely difficult or impossible. Castor oil, however, a milder irritant than some others, has been found to be uniformly efficient. The evening meal is withheld from the patient as a routine and he takes 2 ounces of castor oil; the following morning he cleanses the distal part of the colon and rectum by a plain enema. After this procedure the colon is found collapsed and its lumen free of fecal residue. The routine is broken only for patients with severe diarrhea, and occasionally in cases of acute or subacute obstruction.

In the unusual case, when the patient experiences undue difficulty in retaining the enema, and occasionally when it has not been possible definitely to determine the nature of the lesion encountered, or to minimize the spasm accompanying certain types of lesions, it proves helpful to administer an antispasmodic. Inhalation of amyl nitrite sometimes produces the desired effect, but atropine in the form of tincture of belladonna is more efficient and reliable. Sixty drops of the tincture, divided into three equal doses, two of which are taken at an interval of two hours the evening before the examination and the remaining one within

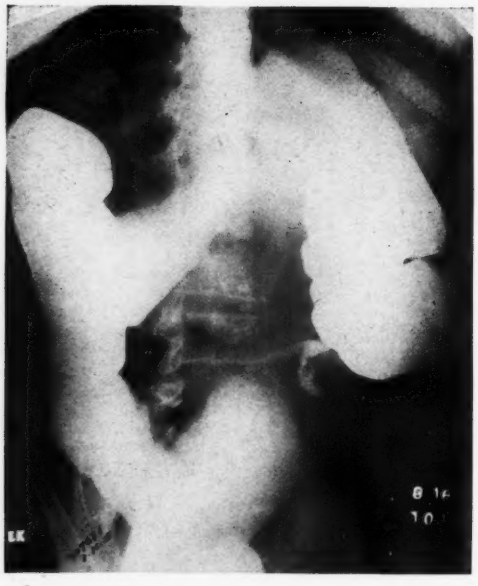

Fig. 3. Extensive filling defect of the transverse colon. At operation a carcinomatous mass, primary in the stomach and extending to the colon, was discovered.

an hour of the examination, is the usual procedure at the Mayo Clinic.

The enema entering the colon is first observed to distend the rectal ampulla so that it extends symmetrically to each side of the median line for a variable distance. The sigmoid usually bends downward, posteriorly and to the left, and, reaching the lateral boundary of the pelvis, continues upward to join the descending colon, forming a Roman "S." Confined as it usually is within the boundaries of the bony pelvis, it is inaccessible to palpation, and the wide rectal ampulla usually obscures the anteroposterior view. The patient must be turned toward the left to obtain an oblique view, and when configuration of the sigmoid is more complex, as frequently occurs, both the right oblique and the left oblique views are necessary. Because palpatory manipulation is so often impossible, direct visualization becomes of paramount importance. The descending colon merges into the transverse colon at the splenic flexure, and while it is not uncommon to see the simple tubular arrangement of these divisions distorted by accessory convolutions, their contours can readily be visualized by oblique views and by manually disengaging the coils. The right portion of the colon and hepatic flexure commonly present a more troublesome task. The transverse dimension has broadened to almost twice the size of any other portion, and the loops are often intricately arranged. The cecum sometimes is firmly fixed to the right abdominal wall, sometimes looped backward and upward behind the ascending colon, now lying low in the pelvis, perhaps obscured wholly or in part by coils of the sigmoid that already are filled with opaque material, now suspended on a short ascending colon, often bound over to the left side of the abdominal cavity by fixation to pelvic viscera. Great patience and much labor are occasionally required to disengage the cecum sufficiently to make a satisfactory examination of its contours.

Palpation often is made difficult because, at this stage of the examination, the colon has been considerably distended and the patient, in an effort to resist the impulse to evacuate the enema, has tensed his abdominal muscles, and manual pressure only tends to aggravate his desire. Observations and conclusions must be made with dispatch and finality. Here the six-hour barium meal, checked carefully both roentgenographically and roentgenoscopically, renders a real service. The underlying principle of the roentgenoscopic method of examining the colon, and the most potent argument for its use, is that it offers an opportunity to bring even the smallest segment of the colon into the direct view of the examiner.

Sometimes, anomalies of position and arrangement make the roentgenologic method impossible, or at least an extremely arduous task. Such anomalies are encountered in partial or complete failure of embryonic descent or rotation, with consequent superimposition of many intestinal coils; entero-

colostomy and enterocolic fistulas cause the small intestine to be filled with opaque material before the colon is visualized.

These technical difficulties, although they render the problem of the roentgenologist more complex, rarely prove to be insurmountable. It seldom occurs that a lesion, if present, cannot be exposed. For the most part, when morbid processes involve the colon, the roentgenologic syndrome is so distinctive and so clear-cut that it has become largely a matter of experience on the part of the investigator accurately to determine the nature of the lesion. The filling defect or organic deformity of the luminal contours is by far the most common roentgenologic sign of disease of the colon. Carcinoma, diverticulitis, tuberculosis, localized chronic ulcerative colitis, localized encroachments on the lumen of the bowel by extrinsic processes, organic inflammatory stricture, and syphilis, named in the order of the frequency of their occurrence, are the processes, some of which constantly, others only occasionally, manifest themselves by the filling defect. In distinguishing these from each other, and from extraneous factors which simulate them, the fluoroscope is the essential instrument of the roentgenologist. He will be constrained at times to elicit every single item of information concerning the lesion at hand, and such items as fixation, constancy during manipulation, mobility and motility, and palpability constitute invaluable differential points.

The filling defect of carcinoma of the colon is annular, polypoid, or obstructing. Each of these types may be attended with some degree of spasm, but in general all are characterized by marked jagged irregularity, constancy of situation, permanence after manipulation, persistence after administration of antispasmodic drugs, and association with a palpable mass. When stenosis is present to a marked degree a bluntly rounded contour may be found at the site of obstruction or very fine canalization may be

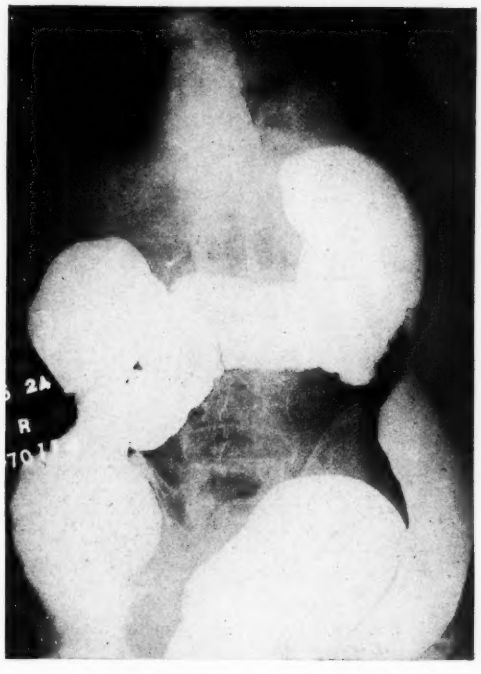

Fig. 4. Organic stricture of the descending colon. Etiology undetermined.

observed. The size of the lesion depends on the extent of the growth. Because diverticulitis involves the sigmoid colon almost exclusively and hence does not lend itself to the complete roentgenologic maneuver, its resemblance to the carcinomatous filling defect often makes differentiation difficult. In general, the shadow of diverticulitis is spindle-shaped, its contours are serrated in a regular fashion, the rough, jagged contours of a malignant lesion are absent, and many or few of the extra-luminal shadows of non-involved diverticula are usually found, and should immediately suggest the diagnosis. Both the attending spastic factor and the mural inflammatory infiltration combine to form the filling defect. The more acute and virulent the process the greater is the spastic manifestation. This factor is reduced to a minimum, although not entirely removed, by the administration, to adequate physiologic effect, of tincture of

Fig. 5. Diffuse narrowing, loss of haustra, and moth-eaten contours of the right half of the colon. The patient has active pulmonary tuberculosis. There is a typical tuberculous deformity in the cecum, which lies low in the pelvis. The importance of the ileocecal coil as a landmark is evident.

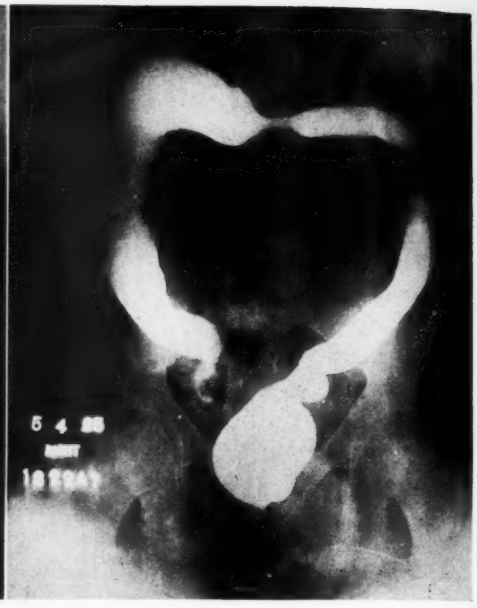

Fig. 6. Chronic ulcerative colitis. The transitory spasm of the transverse colon was absent on subsequent examination.

belladonna. Not uncommonly there is an accompanying palpable mass which lacks the characteristically indurated, knotty character of a malignant growth.

When chronic ulcerative colitis involves only a localized, small segment of the colon, the abrupt narrowing of the affected portion and the moth-eaten appearance of the contours of the barium-filled canalized portion make the lesion bear a strong resemblance to carcinoma (Fig. 1). This type of chronic ulcerative colitis is indeed rare, but the differentiation is highly important because of the divergence of therapeutic procedure which hinges on the diagnostic decision. Contrasted with the characteristics of carcinoma is the hyperirritability usually present with chronic ulcerative colitis, and the relatively broad shadow with smooth margins and the thick, yet pliable, walls in chronic ulcerative colitis.

Deformities of the colon due to extrinsic lesions are of two types, depending on whether they are the result of an extraneous growth (Fig. 2) or a mass impinging on the lumen of the bowel or completely encircling it, or whether they are due to spasticity caused by an inflammatory or exudative lesion in the immediate neighborhood. Pelvic tumors and inflammatory masses, enlarged spleen, hydroptic gall bladder, extensive carcinoma of the stomach and pancreas (Fig. 3), and post-peritoneal masses, have been found to be responsible for deformities of the first type. Perforating duodenal, gastric, and gastrojejunal ulcers, subacute appendicitis and tuberculous vesiculitis, have been found associated with spastic deformities of the second type. Careful manipulation and effective use of an antispasmodic usually will disclose the absence of primary involvement of the bowel in the spastic type. The smooth outline and the presence of a normal mucosal contour rule

out an intrinsic lesion of the colon in the first type.

Organic stricture (Fig. 4) is exceedingly uncommon except as a complication of chronic ulcerative colitis. A short segment is usually involved, the narrowing is spindle-shaped, and the lesion is flexible and has a very smooth, regular outline. Syphilitic involvement of the colon also is rare. A single case in my experience showed the rectum and entire sigmoid colon to be involved in marked, uniformly diffuse narrowing, the diameter of the affected segment having been reduced to about 1 cm. throughout its entire extent.

Tuberculosis of the colon must be distinguished from several diseases which affect the right side of the colon. One group of diseases which exhibit nearly identical roentgenologic morphology is composed of tuberculosis, carcinoma, localized chronic ulcerative colitis, and the deformity produced secondary to pericecal abscesses, usually appendiceal. A second group includes tuberculosis, amebic colitis, and chronic ulcerative colitis. The first has the filling defect as its especial manifestation; the second is characterized by extensive diffuse narrowing, loss of haustra, and mucosal destruction.

Any type of ulceration of the colon, malignant or benign, may produce the Stierlin sign. This phenomenon is not always pathognomonic for tuberculosis. Since primary tuberculosis of the colon is so exceedingly rare in the absence of active pulmonary tuberculosis, the roentgenologic diagnosis of tuberculous colitis is based on the demonstration of a filling defect which usually extensively involves the cecum and ascending colon, of a markedly irregular and corrugated outline, and a peculiar boggy consistence of the bowel, all in association with active pulmonary tuberculosis. Usually only a short segment of ascending colon is involved with the cecum in a pericecal inflammatory mass. The narrowing of the lumen may be great, due to the marked inflammatory mural thickening, but the contours of the barium-filled canalized portion are smooth; the course of this portion is tortuous, and the mucosa is intact.

Of fundamental importance in the differentiation of the second group of diseases of the right side of the colon is the course of events in their pathologic development, especially with reference to the site of the initial lesions and the progression of the disease. Chronic ulcerative colitis characteristically begins in the rectum and progresses proximally; amebic ulcerative colitis and tuberculous ulcerative colitis, on the other hand, have their primary lesions in the cecum and progress distally. The presence of tuberculous colitis is postulated or ruled out by the findings in the thorax. The comparatively mild form of amebic colitis seen in northern latitudes has a roentgenologic appearance similar to that of chronic ulcerative colitis in that the affected portion of the colon is hyperirritable, the haustra are subdued, and signs of mucosal destruction are present; but the colon preserves its pliability, thickening of the wall is not so severe, peristalsis is not so markedly interfered with, and the entire process does not give the impression of the severity observed in chronic ulcerative colitis. In the presence of active pulmonary tuberculosis with such roentgenologic findings in the colon, clinical and other laboratory data will be necessary securely to establish the diagnosis (Fig. 5).

Of all the simulators of the filling defect, spasm is the most frequently encountered. Transitory spasm (Fig. 6) will be met with in almost every colon examined, and is to be expected if for no other reason than the unnaturalness of the procedure, the rigor of the preparation, and the emotional factors, such as fear and apprehension, which every patient exhibits to some extent. Permanent spasm is an indicator or secondary

sign, not always of a local lesion in the colon, but often of some extrinsic lesion in the abdominal cavity. Other conditions imitating the filling defect are gas, feces, and retained pockets of fluid. Emphasis has been laid on the importance of rigid preparatory technic to reduce their occurrence to a minimum. Pressure of ribs on the segments of the colon near the hepatic and splenic flexures, and pressure of the spinal column on the middle portion of the transverse colon will be factors of error only when roentgenographic data alone are relied on. Adhesions are not commonly the cause of deformities of the colon and interference with the integrity of the lumen is exceedingly rare.

The demonstration and identification of simple benign polyps, especially when they are not large, is still a largely unsolved roentgenologic problem. Care must be taken not to confound the spherical, regular projections into the lumen of fecal remnants with polypoid projections. Since polypoid tumors are known to be attached at times by pedicles extremely long, this mistake is not easily avoided. It is frequently necessary to re-examine after another preparation to verify the observations.

DISCUSSION

Dr. Paul C. Hodges (Chicago): Dr. Weber in presenting his paper and Dr. Jenkinson in discussing it have stressed the importance of preparation of the colon in patients who are to be subjected to X-ray examination after the administration of a barium enema. I wish to ask whether they base their opinion on the popular views on this subject or upon their own experimental evidence. Up until a short time ago I shared the general view as to the necessity of colon preparation. At times, however, I have been under a good deal of pressure from one of my colleagues who wished to spare his patients the rigor of a cleansing enema. With the idea of demonstrating to him conclusively that it was a mistake to think of doing the barium enema without preparation, I had him send me a group of students, half of whom had been prepared, half coming directly from their class-rooms without preparation. No information was given to me to indicate that these subjects were students. They were mixed in with the regular run of patients for the day and I had no clue as to the presence or absence of abnormal clinical findings. To my surprise, I found that the X-ray examination gave no clue as to whether or not preparation had been done, and apparently the colon full of its normal fecal content received the barium enema just as easily as the colon that had been carefully emptied.

I still feel that certain cases need preparation, particularly patients long bedridden or patients with partial intestinal obstruction. Unfortunately, however, these very cases that need preparation are not easily prepared, and I hope that Dr. Weber will repeat for me the exact details of the preparation he uses so that I may try his method on refractory cases.

Dr. Weber stresses the importance of using belladonna where spasm of the intestine is suspected. I have had no success at all in the use of belladonna and would like to hear from Dr. Weber just how he uses the drug to get the desired effect.

Dr. Weber's statement that filling of the terminal ileum was looked for as an important landmark pleased me. As you all know, a popular belief exists that there is significance of some sort in the filling or lack of filling of the terminal ileum after administration of a barium enema. So far as I know, there is no physiological or clinical evidence to support this view.

Dr. Weber (closing): Routinely at the Mayo Clinic the colon examinations are made early in the morning. On the evening

before the examination the patient abstains from his evening meal and takes two ounces of castor oil; and on the following morning he is directed to take plain water enemas until they return clear. Usually not more than two of these injections are necessary, since the castor oil is expected to have achieved thorough cleansing of that portion of the colon proximal to the rectosigmoid, and the enemas are considered necessary only to remove thoroughly all fecal material from the rectal ampulla. I have not formally tried to examine the colon without any attempt at previous thorough cleansing of the bowel. However, I have found that frequently enough the routine preparation outlined above, which to some might seem quite vigorous, has been inadequate to secure a satisfactory cleansing of the colonic lumen; furthermore, I have repeatedly tried to inflict the examination of the colon by the barium enema upon patients who, either because they had been misdirected by referring physicians or had misunderstood given directions, had failed to make any effort at preparation. In no case could I feel qualified to render a roentgenologic opinion as to the integrity of the colon in these cases.

I object to any departure from the routine preparation for several reasons. In the first place, feces in the colon, like food in the stomach, can closely simulate pathologic processes. In the second place, since proper exposure of the segment of the colon involved in the pathologic process is the first and most important requirement for correct diagnosis, it is necessary to render the complex anatomic arrangement of the colon as simple as possible. The unprepared or the improperly prepared colon is likely to be dilated by its fluid or solid contents, thus rendering superimposed loops more difficult to separate and examine. Important diagnostic data are obtained from the estimation of any diversions from the normal roentgenologic appearance of the contours of the lumen of the colon. Fecal material, intestinal secretions, and excess fluid in the colon interfere with these appearances.

Tincture of belladonna, administered by mouth, has been the most uniformly satisfactory antispasmodic in my experience. Inhalation of amyl nitrite, as mentioned by Dr. Jenkinson, administered during the course of the examination, is also very useful. Either will sometimes fail to produce the desired result.

As indicated in the paper, the terminal ileum is used as a landmark to indicate that the entire cecum has been filled. Furthermore, its visualization adds so many more segments of intestine upon which a roentgenologic opinion can be rendered.

A CHEMICAL METHOD FOR THE MEASUREMENT OF QUANTITY OF RADIATION[1]

By EDITH H. QUIMBY, M.A., and HELEN R. DOWNES, PH.D.
Departments of Biophysics and Chemistry, Memorial Hospital, NEW YORK CITY

THE international unit of roentgen radiation has been defined in terms of the amount of ionization produced in a cubic centimeter of air under certain specified conditions. This ionization is to be measured by means of a standard chamber the specifications of which have not yet been agreed upon by the various committees interested in the problem. However, even when the standard instrument is decided upon, it will not be a practical device for general use. The primary standard for the United States will be at the Bureau of Standards, and there will be copies of it in a few laboratories, but for the most part measurements of radiation quantities will have to be made by means of some secondary standard. Ionization chambers of various sorts are already in use for this purpose, and these can be calibrated by direct comparison with a standard instrument, provided they meet certain minimum requirements.

It seems, however, that there is a need for a simple, accurate, reliable method of measuring quantity of radiation which is not dependent on specialized apparatus. This would permit easy duplication of results in various parts of the world without the necessity for actual comparison of instruments. Wood (1) has proposed such a method with *Drosophila* eggs, but in this case various technical difficulties may arise if a trained biologist is not available.

A very satisfactory method could be developed from a chemical change induced by radiation, provided it possessed certain characteristics. The chemical substances used must be fairly inexpensive, and easily obtainable in the required purity. The method of measuring the reaction produced should be simple enough to be mastered by the average trained technician or radiological interne, and it should not require expensive or elaborate apparatus. A readily measured change should be produced by amounts of radiation of the order of magnitude of those used in therapy, and there should be no spontaneous reaction going on for which corrections need be made.

A great many chemical changes are produced by the action of radiation, but very few of these are suitable for the purpose here considered. The first type of reaction which may be thought of is the darkening of a photographic film. In this case a standard material is readily obtained and handled, and within a rather wide range the amount of change produced may be measured quite easily. However, the sensitivity is so great that complete blackening occurs with quantities of radiation of the order of 1 per cent of that required to produce a skin erythema. That is, with a regular therapy type of radiation, the time of exposure would have to be too short to measure conveniently, or the distance from the X-ray target to the film very great. The use of either very long distances or very short times introduces difficulties which need not be discussed here. Also standard films must be made and developed with each set of test films and even then slight variations in development technic and solutions may make accurate comparison difficult. The apparatus for determining the density is no simpler than many ionization instruments. This reaction, therefore, is not practical for use in such a standard procedure.

[1]The expenses of this research were partially defrayed by the Littauer Fund for Cancer Research.

Another type of transformation which has been quite widely studied is the inactivation of enzymes. Hussey and Thompson (2, 3) and Clark and Northrop (4) have carried out extensive experiments on trypsin, pepsin, and invertase. But the amounts of radiation required to produce effects on these substances are much greater than those used in therapy. That is, with therapy machines, very long exposures are necessary. Technical difficulties in handling the substances are many, and there is a spontaneous inactivation which must be allowed for. Fricke and his co-workers (5, 6) have studied the transformation of oxyhemoglobin to methemoglobin, and the oxidation of ferrous sulfate. The exposures necessary to produce these reactions are less than in the case of enzymes, but they are still rather large. The first substance is complicated to prepare and work with, and the second requires an elaborate analytical procedure. The disappearance of cholesterol from solutions (7, 8), and the inversion of sucrose (9) have been investigated, but they are all subject to one or more of the disadvantages mentioned above.

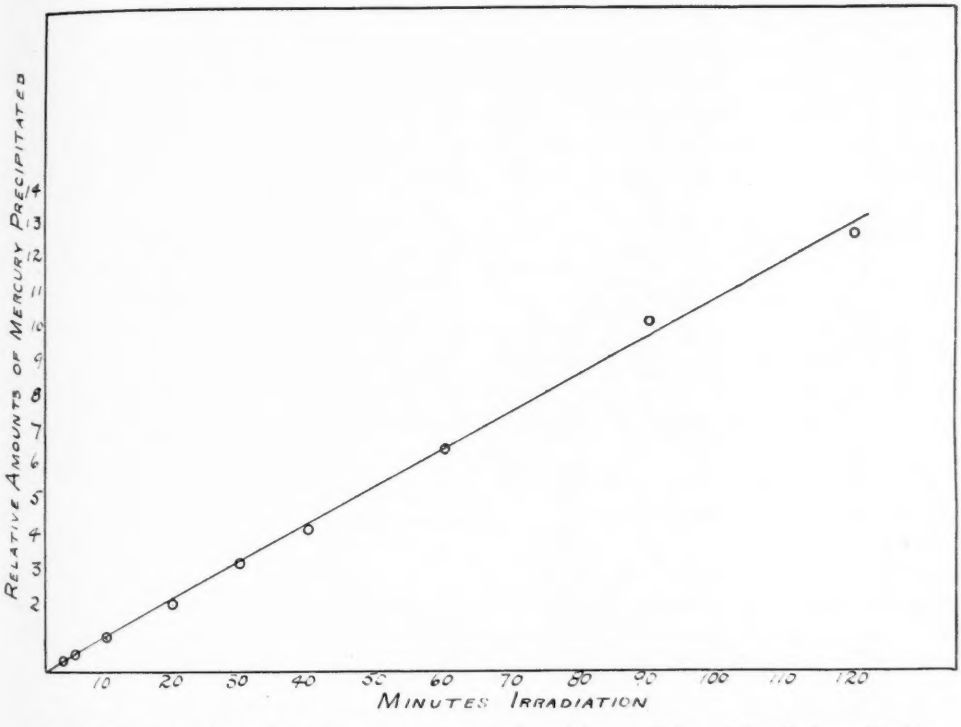

Fig. 1. Curve showing relation between amountnt of precipitate and time of irradiation—all other factors remaining constant.

In contrast to all of these is the reaction suggested by Wyckoff and Baker (10), the precipitation of mercurous chloride from the mixture of ammonium oxalate and mercuric chloride known as Eder's solution. Working with practically unfiltered X-rays produced at about 30 K.V. they found satisfactory amounts of precipitate were produced by exposures of from fifteen minutes to six hours, the amount formed being proportional to the time of irradiation, all other factors remaining constant. They used 20 c.c. of the mixed solution and deter-

mined the amount of the precipitate by filtering on glass filters, drying, and weighing.

It seemed necessary, if the procedure were to be made available to clinicians, to work out a method for the estimation of mercurous chloride which would be simple and accurate and more rapid than Wyckoff and Baker's. For this purpose we have developed a modification of Hempel's old method for estimating mercury as mercurous chloride by means of iodine and sodium thiosulphate. All the chemicals needed are readily obtainable in the pure state. The procedure calls for but one accurately standardized solution, that of sodium thiosulphate, and this keeps well for periods of several months. The estimation is rapid, and, with due observation of certain precautions, simple to carry out. We have used it for the determination of amounts of mercury ranging from 0.3 to 30 mg. and have been able to work with as little as 0.7 c.c. of the mixed Eder's solution.

SOLUTIONS REQUIRED

Mercuric Chloride. 0.4 Normal. Dissolve 54 gm. of pure mercuric chloride in 1 liter of hot distilled water. After cooling, filter into the supply bottle.

Ammonium Oxalate. 0.5 Normal. Dissolve 32 gm. of pure ammonium oxalate in 1 liter of hot distilled water. After cooling, filter into the supply bottle.

Iodine. 0.1 Normal in iodine. Dissolve 45–50 gm. of pure potassium iodide in 25 to 30 c.c. of distilled water in a 1 liter flask. In this concentrated solution dissolve 12 to 13 gm. of iodine crystals and *after they have completely dissolved,* make up to 1 liter. This gives a solution which is approximately 0.1 normal in iodine and this is accurate enough, as the concentration changes on standing, and a blank must be done every day in any case.

Sodium Thiosulphate. 0.1 Normal. This is the stock solution of thio, and can be obtained accurately standardized from a chemical supply house such as Eimer and Amend. For the convenience of those who may desire to make up and standardize the solution for themselves, the method of standardization in use in this laboratory is given in an appendix to the present paper. For the actual estimation of mercury this 0.1 normal solution is diluted ten or twenty times to give N/100 or N/200 thio as it is needed.

Starch. Dissolve one gram of soluble starch previously mixed with a little cold water, in 100 c.c. of boiling water and allow to boil for five minutes. Fresh starch solution should be made up every few weeks.

The experiments to be reported in this paper have almost all been done with 5 c.c. of the mixed Eder's solution. The solutions of mercuric chloride and ammonium oxalate are kept in stock and 2.5 c.c. of each transferred to a small crystallizing dish about 5 cm. in diameter just prior to irradiation. At the end of the period of irradiation the contents of the crystallizing dish are washed into a 25 c.c. centrifuge tube, and the mixture centrifuged for about five minutes at about 1,900 revolutions per minute. The supernatant liquid may be poured or siphoned off; the precipitate is then washed by blowing a sharp jet of water into it, and so mixing it well with the wash water. After a second centrifuging the wash water is poured off and the precipitate is ready for estimation. This depends on the fact that mercurous chloride is oxidized by iodine in the presence of a large excess of potassium iodide to potassium mercuric iodide, which goes into solution.

$$2HgCl + 6KI + 2I = 2HgK_2I_4 + 2KCl$$

The amount of iodine left in the tube is readily estimated by direct titration with sodium thiosulphate.

$$2Na_2S_2O_3 + I_2 = 2NaI + Na_2S_4O_6$$

Comparison of this with a blank titration

of exactly the same amount of iodine solution as originally used for the oxidation measures the amount of iodine which disappeared in oxidizing the mercurous chloride. One c.c. of N/200 iodine used is equivalent to 1 mg. of mercury in the form of mercurous chloride.

For the oxidation it is better to use a small amount of a fairly strong iodine solution than a larger amount of a dilute one, even for small amounts of precipitate, and we have used for all experiments to be reported 0.1 normal iodine solution containing 50 gm. of potassium iodide per liter. For amounts of mercurous chloride corresponding to between 0.3 and 5.0 mg. of mercury, 0.5 c.c. of this iodine solution is added directly to the precipitate in the centrifuge tube and stirred slowly until the precipitate dissolves. It is important at this stage to avoid unnecessary exposure of the iodine solution to the air, and so until the main precipitate has completely dissolved it should not be washed up on the walls of the tube more than can be helped. The tube is then inclined and any traces of precipitate adhering to the upper walls are quickly dissolved in the iodine by rotating the tube slowly and rubbing the precipitate with a stirring rod. The iodine itself is then promptly rinsed back into the tip by a fine jet of water from a wash bottle. The remaining iodine is then titrated with 0.005 N. thiosulphate, first until the iodine color has almost disappeared and then, after addition of one drop of starch solution, until the disappearance of the last trace of blue color. The end point, even with so dilute a solution of thiosulphate is beautifully definite, and the blue color should not return on standing. To be sure that all trace of blue color has disappeared, it is safest to look down into the solution from the top before deciding that the final drop of thio has been added. The loss of iodine is estimated by titrating a blank, and we find it advisable to put the 0.5 c.c. of iodine into a centrifuge tube, to tip the tube and run it around the upper walls and to wash it down exactly as in the experimental tube, so that any inevitable loss from the iodine by evaporation may be duplicated in the blank. Since 1 c.c. of normal thiosulphate is equivalent to 200 mg. of mercury in the original precipitate, the amount of mercury precipitated is obtained in mg. by multiplying the difference between the blank and experimental titrations in c.c. by 200 and by the strength of the thiosulphate.

The precautions which we have found necessary are as follows: (1) All glassware used must be absolutely clean and free from grease. The small crystallizing dishes and the centrifuge tubes are soaked in cleaning mixture before each using. In the case of the crystallizing dishes this makes it possible to obtain an absolutely clear solution when the mercuric chloride and the ammonium oxalate solutions are mixed, and this solution if protected from direct light should remain very nearly clear for several hours. (2) For measuring the iodine solution, Ostwald pipettes are best. They must be allowed to drain slowly, and the time of draining and the amount of subsequent blowing to empty the pipette should be exactly the same whenever that pipette is used. The use of a strong solution, which is to be titrated with a very much weaker one introduces a possibility for error unless the procedure is carried out with great uniformity, for minute variations in the amount of iodine delivered will show up in the titrations in differences of as much as 0.5 c.c. of thiosulphate. It is possible, however, with due attention to uniformity, to obtain blank titration figures for as little as 0.5 c.c. of iodine which will vary by only 0.1–0.2 per cent—that is, by 0.01–0.02 c.c. (3) The iodine should be added to the washed precipitate immediately before the titration and never allowed to stand indefinitely after

being measured. In general we have found that following irradiation the solutions can be allowed to stand for reasonable lengths of time before centrifuging the mixture, but it is probably safer to spin immediately after irradiation, to pour off the supernatant liquid and add the wash water. At this stage, or after the second spinning, the tubes may be closed with stoppers and allowed to stand for twenty-four hours if necessary. The wash water keeps the precipitate from possible oxidation through exposure to air, and the removal of the excess Eder's solution prevents any possible spontaneous precipitation of mercurous chloride. But once the iodine has been added, titration should take place immediately, as volatilization of iodine becomes measurable after a short time. It is for this reason that the titration is better performed in the rather constricted space of a centrifuge tube, than after washing the precipitate into a more convenient beaker. If the amount of precipitate requires a volume of iodine and consequently of titrated thiosulphate greater than the tube will hold, we find it better to use stronger thio than to transfer the precipitate to an open beaker. (4) Sufficient iodine should be taken for each titration, so that not much more than half of it is used to oxidize the mercury. This expedites solution of the mercurous chloride, and leaves a readily titratable amount of iodine. We have found no difficulty in measuring as little as 0.35 mg. of mercury by this method, when the difference measured by titration would be approximately 0.35 c.c. of thio.

Table I gives a typical experiment in which four 5 c.c. samples were exposed in sequence to 3-minute radiations under identical conditions.

The range over which the reaction is useful as a standard has been investigated by determining the relation between time of irradiation and amount of precipitate formed, other conditions remaining the same.

TABLE I

No.	c.c. I_2 Used	Blank[2] c.c. thio	c.c. thio titr.	c.c. thio $\rightleftharpoons$ Hg	Mg. Hg
1	0.5	10.65	10.30	0.35	0.322
2	0.5	10.65	10.30	0.35	0.322
3	0.5	10.65	10.28	0.37	0.340
4	0.5	10.65	10.30	0.35	0.322

[2]Normality of thio=0.0046 N.

Exposing 5 c.c. of solution to radiation generated at 200 K.V. and 10 ma. with a filter of 0.5 mm. of copper, plus 1 mm. of bakelite, and a distance of 42 cm. from the target to the surface of the solution, the amount of precipitate formed was found to be exactly proportional to the time of exposure for irradiations varying from 3 minutes to 2 hours. Figure 1 presents the results of such a series of experiments. They were done on several different days, and the points on the curve are expressed in terms of the relative amount of mercury precipitated, taking the 10-minute exposure for that day as a base. The 10-minute exposures for the four different days differed among themselves by only 5 per cent, and three of the four by less than 2 per cent. Each point on the curve represents the average of several observations, which did not differ by more than a few per cent among themselves. It will be seen that a straight line may be drawn through the points so that the greatest deviation in any experimental point is less than 5 per cent. The curve goes through the origin, indicating that probably the proportionality holds for quantities of precipitate too small to measure by the method herein described and that there is little if any spontaneous reaction. The data from which the curve is plotted are given in Table II.

Figures 2 and 3 present typical curves of the sort usually made by ionization measurements, and Tables III and IV give the data in detail. Figure 2 shows the

TABLE II

VARIATIONS IN THE AMOUNT OF HgCl PRECIPITATED WHEN 5 C.C. OF EDER'S SOLUTION IS IRRADIATED FOR DIFFERENT LENGTHS OF TIME AT 200 K.V., 10 MA., WITH 0.5 MM. OF COPPER AND 1 MM. BAKELITE FILTER, AND WITH 42 CM. DISTANCE FROM TARGET TO TOP OF SOLUTION

Date, Dec., 1929	No.	Time Rad. Mins.	c.c. I_2	Blank c.c. thio[a]	c.c. thio titr.	c.c. thio Hg	Mg. Hg ppt.	Actual ratio	Theoret. ratio
11	1	3	0.5	10.65	10.30	0.35			
	2	3	0.5	10.65	10.30	0.35			
	3	3	0.5	10.65	10.28	0.37	0.331	0.335	0.333
	4	3	0.5	10.65	10.30	0.35			
	5	5	0.5	10.65	10.05	0.60			
	6	5	0.5	10.65	10.07	0.58			
	7	5	0.5	10.65	10.02	0.63	0.552	0.497	0.500
	8	5	0.5	10.65	10.07	0.58			
	9	10	0.5	10.65	9.40	1.25			
	10	10	0.5	10.65	9.45	1.20			
	11	10	0.5	10.65	9.42	1.23	1.11	1.00	1.00
	12	10	0.5	10.65	9.48	1.18			
	13	20	0.5	10.65	8.35	2.30			
	14	20	0.5	10.65	8.32	2.33	2.14	1.93	2.00
	15	20	0.5	10.65	8.29	2.36			
16	1	10	0.5	10.38	9.30	1.08			
	2	10	0.5	10.38	9.20	1.18	1.09	1.00	1.00
	3	10	0.5	10.38	9.20	1.18			
	4	30	0.5	10.38	6.69	3.69			
	5	30	0.5	10.38	6.75	3.63	3.36	3.10	3.00
	6	30	lost						
	7	40	0.5	10.38	5.53	4.85			
	8	40	0.5	10.38	5.49	4.89	4.42	4.06	4.00
	9	40	0.5	10.38	5.68	4.70			
18	1	10	0.5	10.29	9.11	1.18			
	2	10	0.5	10.29	9.08	1.21	1.10	1.00	1.00
	3	60	1.0	20.68	13.20	7.48			
	4	60	1.0	20.68	13.00	7.68	6.98	6.33	6.00
	5	90	1.0	20.60	8.85	11.75	10.80	9.80	9.00
19	1	90	1.0	20.30	8.20	12.10	11.13	10.20	9.00
20	1	10	0.5	10.10	8.96	1.14			
	2	10	0.5	10.10	8.96	1.14	1.06	1.00	1.00
	3	10	0.5	10.10	8.94	1.16			
	4	120	1.0	20.30	5.55	14.75	13.58	12.80	12.00
21	1	120	1.0	19.95	5.45	14.50	13.35	12.20	12.00

[a]Normality of thio=0.0046 N.

change in amount of precipitate with variation in thickness of copper filter, all other factors remaining constant. That is, it is an absorption curve in copper for X-rays of a certain quality. The absorption curve obtained with the same filters by ionization measurements made with a small spherical graphite chamber is shown in the dotted line so plotted as to coincide with the chemical curve at 0.5 mm. copper. For this particular experiment X-rays at 200 K.V. and 30 ma. were used. Five c.c. of the mixed solution in a small crystallizing dish was supported on a thin sheet of bakelite 42 cm. below the target. A 1 mm. bakelite filter was placed on top of the crystallizing dish and the copper filters 5 cm. above it. Each irradiation was of 15 minutes' duration. The ionization chamber was 55 cm. farther below the X-ray tube than the solutions were, so that for the radiation transmitted by thin filters the intervening air might

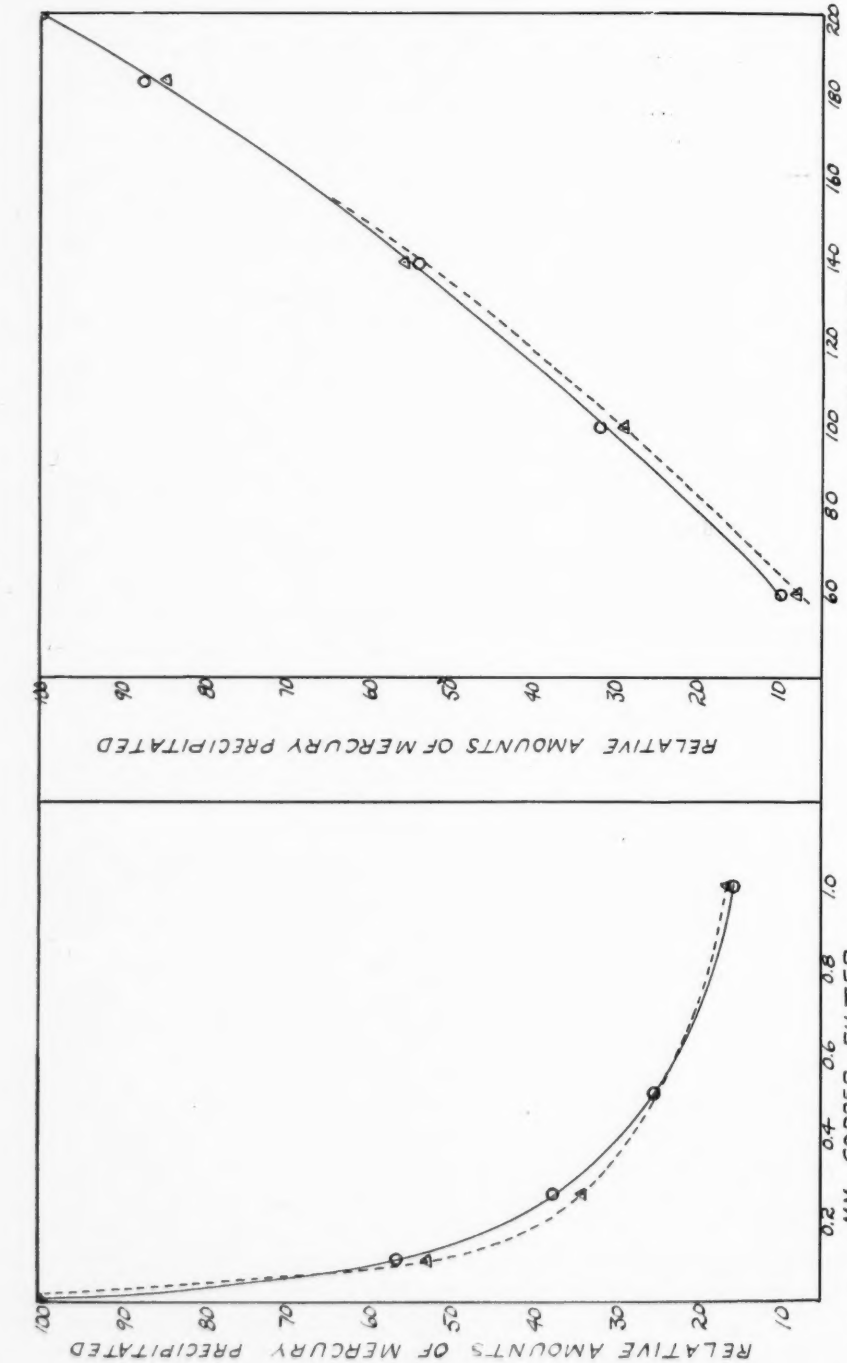

Fig. 2. Curve showing relation between amount of precipitate and thickness of copper filter—all other factors remaining constant (dotted curve—ionization relation).

Fig. 3. Curve showing relation between amount of precipitate and voltage—all other factors remaining constant (dotted curve—ionization relation).

TABLE III

VARIATIONS IN THE AMOUNT OF HgCl PRECIPITATED FROM 5 C.C. OF EDER'S SOLUTION IRRADIATED FOR 15 MINUTES AT 200 K.V. AND 30 MA. WHEN THE THICKNESS OF COPPER FILTER IS VARIED

No.	Thickness of Cu	c.c. I_2	Blank c.c. thio[4]	c.c. thio titr.	c.c. thio Hg	Mg. Hg ppt.
1	1.00 mm.	1 c.c.	8.47 c.c.	6.70 c.c.	1.77	
2	1.00 mm.	1 c.c.	8.47 c.c.	6.80 c.c.	1.67	4.04
3	1.00 mm.	1 c.c.	8.47 c.c.	6.76 c.c.	1.71	
4	0.50 mm.	1 c.c.	8.47 c.c.	5.88 c.c.	2.59	
5	0.50 mm.	1 c.c.	8.47 c.c.	5.96 c.c.	2.51	6.15
6	0.50 mm.	1 c.c.	8.47 c.c.	5.72 c.c.	2.75	
7	0.26 mm.	1 c.c.	8.65 c.c.	4.82 c.c.	3.83	
8	0.26 mm.	1 c.c.	8.65 c.c.	4.76 c.c.	3.89	9.06
9	0.26 mm.	1 c.c.	8.65 c.c.	4.79 c.c.	3.86	
10	0.10 mm.	2 c.c.	17.30 c.c.	11.37 c.c.	5.93	
11	0.10 mm.	2 c.c.	17.30 c.c.	11.60 c.c.	5.70	13.56
12	0.10 mm.	2 c.c.	17.30 c.c.	11.60 c.c.	5.70	
13	No Cu	2 c.c.	17.30 c.c.	6.72 c.c.	10.58	
14	No Cu	2 c.c.	17.30 c.c.	7.17 c.c.	10.13	24.20
15	No Cu	2 c.c.	17.30 c.c.	7.12 c.c.	10.18	

[4]Normality of thio=0.01176.

cause a difference in the percentage registered. The figure shows the two curves to be of essentially the same shape; there would be no reason to expect them to coincide. Absorption curves obtained with two ionization chambers of somewhat different construction may differ more than these.

Figure 3 shows the variation in the amount of precipitate with variation in voltage for 10 ma. and a filter of 0.1 mm. of copper plus 1 mm. of bakelite, other factors than the voltage remaining constant. The dotted line is again the ionization curve. The experimental conditions were similar to those outlined above.

Comparison between the graphite ionization chamber and the standard "open air" chamber shows a fairly close agreement between the two for radiation of the quality range considered. Therefore it is evident that data obtained by the use of this chemical reaction, under the conditions here outlined, will not be very different from those obtained by means of the standard ionization chamber. In fact it may be possible so to adjust the concentration, thickness of liquid in the dish, etc., that a very close agreement will be obtained for most practical purposes. It is evident, then, that a calibration can be prepared relating mg. of Hg precipitated per c.c. of solution to r-units of radiation delivered, for any special quality of radiation. For example, a mechanically rectified therapy machine op-

TABLE IV

VARIATIONS IN THE AMOUNT OF HgCl PRECIPITATED BY IRRADIATION OF 5 C.C. OF EDER'S SOLUTION FOR 15 MINUTES AT 10 MA. AND VARYING VOLTAGES

No.	Voltage K.V.	c.c. I_2	Blank c.c. thio[5]	c.c. thio titr.	c.c. thio $\rightleftharpoons$ Hg	Mg. Hg ppt.
1	200	0.5	8.62	3.70	4.92	
2	200	0.5	8.62	3.85	4.77	4.46
3	184	0.5	8.62	4.42	4.20	
4	184	0.5	8.62	4.37	4.25	3.92
5	184	0.5	8.62	4.30	4.32	
6	140	0.5	8.62	5.82	2.60	
7	140	0.5	8.62	5.73	2.69	2.42
8	140	0.5	8.62	5.83	2.59	
9	100	0.5	8.62	7.08	1.54	
10	100	0.5	8.62	7.12	1.50	1.42
11	100	0.5	8.62	7.05	1.57	
12	60	0.5	8.62	8.12	0.50	
13	60	0.5	8.62	8.20	0.42	0.43
14	60	0.5	8.62	8.12	0.50	

[5]Normality of thio=0.0046.

erating at 200 K.V., 5 ma., 0.5 mm. Cu plus 2.5 mm. Al filter, 50 cm. target skin distance, delivers 11.4 r-units per minute. In 5 c.c. of solution exposed to this radiation for 74 minutes 2.91 mg. of Hg were precipitated. That is, 0.58 mg. of Hg per c.c. for 840 r-units (74×11.4=840) or one erythema dose of radiation of this quality. Table V presents the results of several such comparisons, for radiations of different qualities. Here we have taken 840 r (measured in air) as the quantity of filtered radiation necessary to deliver a threshold erythema dose in one exposure. The number of r-units in each case was determined by means of an ionization chamber which had been calibrated by direct comparison with an open air chamber, for radiation of the quality considered. It is seen that, over a considerable range of voltages and filters, the amount of mercury precipitated by this quantity of radiation is 0.58 mg., with an experimental variation of less than 3 per cent.

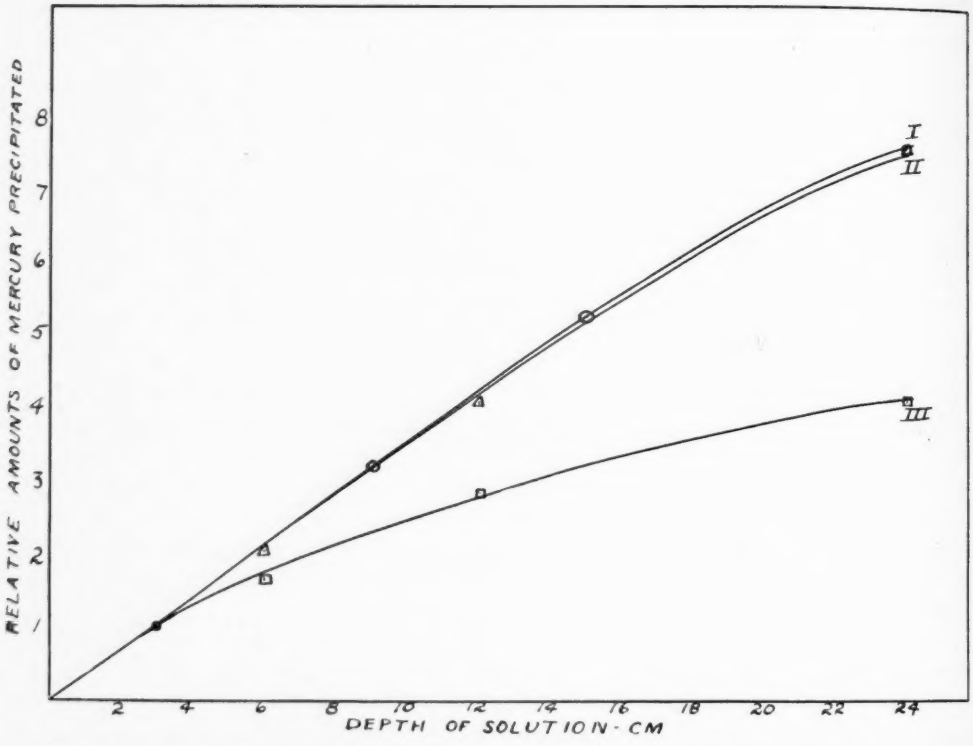

Fig. 4. Curves showing relation between amount of precipitate and depth of solution—distance from target to surface of solution and all other factors remaining constant. I. 200 K.V., 0.5 mm. copper and 1 mm. bakelite. II. 120 K.V., 0.1 mm. copper and 1 mm. bakelite. III. 60 K.V., 1 mm. bakelite.

From these data it is apparent that the output of an X-ray machine can be obtained in r-units by a test with Eder's solution. For instance, a certain machine operating at 190 K.V., 20 ma., with 0.75 mm. Cu and 1 mm. Al filter, at a distance of 50 cm. precipitated 1.97 mg. of mercury in 5 c.c. of solution in 20 minutes. This is 0.39 mg. per c.c. in 20 minutes or (.39/.58×840)= 565 r in 20 minutes. Hence the output of

TABLE V

RELATION BETWEEN AMOUNT OF HgCl PRECIPITATED AND QUANTITY OF RADIATION MEASURED IN r-UNITS

X-ray machine	K.V.	Ma.	Filter mm.	T-S distance cm.	r-units per minute	Time min.	Total r	Mg. Hg per c.c.	Mg. Hg per 840 r
Therapy I	200	5	0.5 Cu 2.5 Al	50	11.4	72	820	0.568	0.582
Therapy II	185	20	0.5 Cu 5 cm. oil	50	36.7	28	1030	0.725	0.592
Therapy II	185	20	0.5 Cu 5 cm. oil	50	28.1	28	787	0.548	0.585
Therapy III	188	20	0.5 Cu 2.5 Al	50	26.2	15	393	0.276	0.590
Experimental	200	30	1.0 Cu	42	71	5	355	0.236	0.560
	200	30	0.5 Cu	42	102	5	510	0.351	0.578
	200	30	0.24 Cu	42	154	5	770	0.530	0.578
	200	30	0.10 Cu	42	233	5	1165	0.784	0.566
Experimental	200	10	0.10 Cu	42	87	15	1310	0.892	0.572
	184	10	0.10 Cu	42	75	15	1130	0.784	0.582
	140	10	0.10 Cu	42	48	15	720	0.484	0.565
							Average		0.577

the machine is 28 r per minute and the time required for one erythema dose is 840/28= 30 minutes for a field of 100 square centimeters.

For such experiments as we have described so far, the volume of solution used is not important, so long as it is kept constant. If the volume is increased, the effect due to scattered radiation is also increased, and the result would be a greater amount of precipitate per cubic centimeter. The reverse effect would be shown if the volume were diminished. However, for quantities of solution of the order of magnitude of those used in this sort of work, the effect of scattering is very small in any case. Since many occasions arise in which it would be advantageous to use a very small volume, we have investigated the effect of using different volumes of solution, from 5 to 40 c.c. in the same crystallizing dishes. Of course this meant that the depth would vary; the top of the solution was kept at a constant distance from the target. It would be expected that for soft radiation, marked absorption would take place in the upper part of the solution so that the amount of precipitate formed would be less in proportion than for hard X-rays, when the depth of solution was considerable. Three qualities of radiation were tested: 200 K.V., filter, 0.5 mm. Cu + 1 mm. bakelite; 120 K.V. 0.1 mm. Cu + 1 mm. bakelite; 60 K.V., 1 mm. bakelite, all other conditions remaining constant. Figure 4 and Table VI give the relation between depth of solution and quantity of precipitate for the three cases. It is evident that for fairly penetrating radiations the depth of the solution may vary within certain limits without introducing an appreciable error, but for soft radiations it is a much more important factor.

We have been interested to see how small a volume of solution can actually be used to give satisfactory results. A tiny closed container of this chemical would in many instances be more convenient to use than a small ionization chamber, if it would give reliable data. This would be the case in measuring the distribution of intensity within and outside a beam of radiation, when it would permit the making of simultaneous rather than successive observations. It would also be useful in the study of scattered and secondary radiation, and in any

TABLE VI

VARIATIONS IN THE AMOUNT OF HgCl PRECIPITATED WHEN DIFFERENT VOLUMES OF EDER'S SOLUTION ARE IRRADIATED UNDER IDENTICAL CONDITIONS IN THE SAME DISHES, THEREBY CHANGING ONLY THE DEPTH. TOPS OF SOLUTIONS AT THE SAME DISTANCE FROM TARGET. IRRADIATION TIME, 5 MINUTES

Depth Soln. mm.	Voltage and filter	Blank c.c. thio	c.c. thio titr.[6]	c.c. thio =○=Hg	Mg. Hg ppt.	Ratio
3	200 K.V.	9.60	7.60	2.00	1.84	1.00
9	0.5 mm. Cu	19.20	12.86	6.34	5.83	3.16
15	1 mm. bakelite	19.20	8.73	10.47	9.63	5.25
24		28.80	13.78	15.02	13.82	7.55
3	120 K.V.	9.88	9.36	0.52	0.48	1.00
6	0.1 mm. Cu	9.88	8.85	1.03	0.95	1.98
12	1 mm. bakelite	9.88	7.78	2.10	1.93	4.03
24		9.88	5.92	3.96	3.64	7.58
3	60 K.V.	10.05	9.40	0.65	0.60	1.00
6	1 mm. bakelite	10.05	8.99	1.06	0.98	1.62
12		10.05	8.20	1.85	1.70	2.84
24		10.05	7.38	2.67	2.46	4.10

[6]Each figure in this column is an average of three estimations. Normality of thio=0.0046 N.

other case where it is desired to approximate as closely as possible the measurement of radiation at a point.

We have found it possible to use 0.70 c.c. of Eder's solution in ordinary gelatin capsules, provided each half of the capsule is first coated with a thin layer of collodion. This is done about two hours before the capsules are to be used, in order to permit as complete an evaporation of the ether as possible. On the other hand, collodion-lined capsules cannot be kept for more than a few hours, as the collodion tends to become dry and cracked. At the end of an exposure the top of the capsule is clipped off with sharp-pointed scissors and the solution and precipitate are washed into a centrifuge tube with several small portions of wash water. The estimation then proceeds as usual.

Figure 5 gives data obtained in this way for the percentage of effective radiation at different distances in wax from a radon tube 14 mm. long with a wall of 0.5 mm. of gold. A hole just large enough to admit the radon tube was bored in a block of beeswax, and around this at different distances holes just large enough to admit the capsules of solution. Some of these irradiations lasted several hours but control capsules of solution did not yield a detectable amount of spontaneous precipitate. This curve is subject to revision; only a small amount of work of this type has been done yet, but we present it to show the possibilities of the method—both with regard to the use of small quantities of solution and to its extension to the measurement of radium radiations. The dotted curve represents values obtained with a small ionization chamber in water.

With regard to the application to radium radiations it may be mentioned that it has not yet been possible to measure gamma rays in terms of r-units, by means of a standard ionization chamber, and that it might be possible to establish a secondary gamma ray standard by means of a chemical reaction.

SUMMARY

The precipitation of mercurous chloride from a mixture of ammonium oxalate and mercuric chloride by the action of roentgen rays has been suggested by Wyckoff and

Baker as a convenient means of measuring quantity of radiation. They have presented data obtained by the use of rather low voltage (30 K.V.) unfiltered radiation, and a gravimetric method of determining the amount of precipitate. We have developed a simple titration method for determining the amount of mercury, and have extended the data to radiation of various qualities from 60 K.V. and no filter, to 200 K.V. and a filter of 0.5 mm. copper. Within rather wide limits the amount of precipitate formed is proportional to the time of irradiation, other factors remaining constant. Satisfactory results can be obtained with volumes of solution of less than 1 cubic centimeter. The method can also be used for radium radiations. Data obtained in this manner differ very little from ionization measurements. A relation has been obtained between quantity of X-radiation measured in r-units, and milligrams of mercury precipitated. It is therefore suggested that this chemical method of measuring quantity of

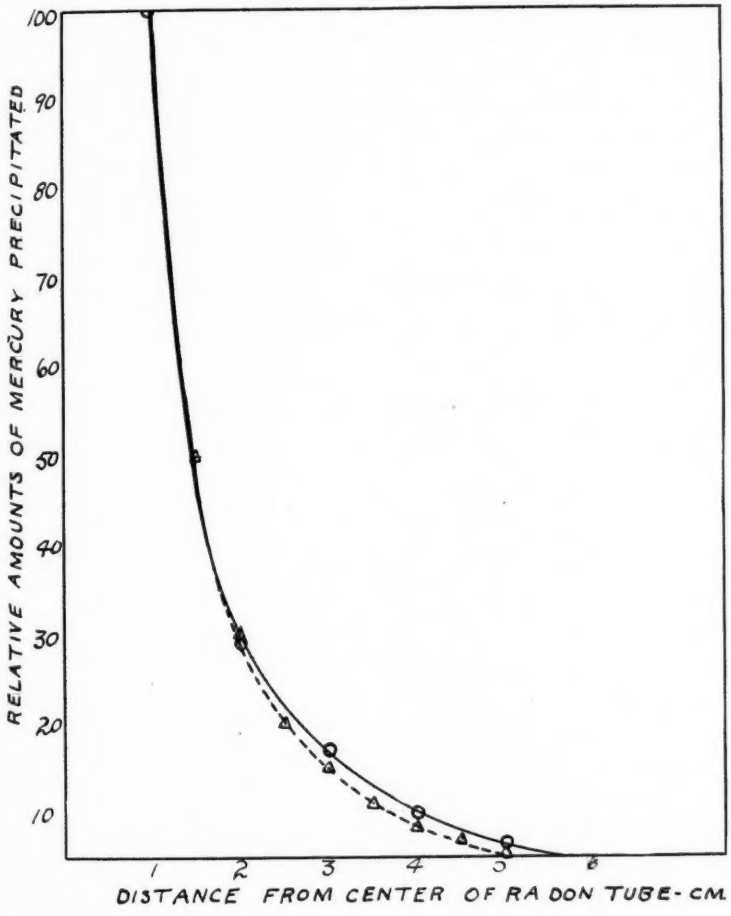

Fig. 5. Curve showing variation of radiation from radon tube, embedded in wax, with distance from center of tube (dotted curve—ionization relation.)

radiation may be useful as a secondary standard, particularly in comparing data obtained in different parts of the world. It also offers a quick, simple method for calibrating the output of an X-ray machine in r-units.

The authors wish to express to Dr. Wyckoff their appreciation of his courtesy in communicating his results to them before publication. They also wish to thank Dr. Failla for his suggestions and interest during the course of the work.

APPENDIX

Standardization of Sodium Thiosulphate

Solutions required:

Iodine. 0.1 Normal. Completely dissolve 20–25 gm. pure KI in a 1 liter flask in about 20 c.c. of water. Add 12–13 gm. of iodine and shake until the iodine has completely dissolved. Dilute to the mark. (This solution cannot be used for estimation of HgCl unless KI is added in the ratio of 25 gm. to the liter.)

Potassium Permanganate. 0.1 Normal. Dissolve 3.2 gm. of pure $KMnO_4$ in 1 liter of water.

Sodium Thiosulphate. 0.1 Normal. This is the stock solution and must be accurately standardized. Dissolve 24.8 gm. of pure sodium thiosulphate crystals in 1 liter of water, and allow to stand for from ten days to two weeks. The amount weighed out need not be measured with great accuracy, as it will act with the carbon dioxide in the water and the concentration of the solution will change slowly for the first few days. After a fortnight, however, it becomes stable and can then be kept for many months without appreciable change. We find it convenient to store it in a bottle with a siphon attached, and a soda lime tube in the cork to prevent access of atmospheric carbon dioxide to the bottle.

When stability has been reached this solution is standardized. In this laboratory we use a standard solution of sodium oxalate as the basis for our standardization of the thio, since pure dry sodium oxalate is readily obtainable from any chemical supply house and need not be purified before use. The solution is made by weighing accurately on an analytical balance of 6.70 gm. of pure, dry sodium oxalate, and making up to exactly 1 liter. This gives a 0.1 normal solution. In order to standardize thiosulphate with this it is first necessary to standardize the solution of potassium permanganate. Twenty-five c.c. of the sodium oxalate solution is transferred to a 250 c.c. conical flask, 20 c.c. of sulphuric acid diluted 1:4 by volume is added, and sufficient boiling water to bring the temperature to approximately 70° C. This mixture is then titrated with the permanganate solution from a burette until a single drop of the permanganate leaves the solution a permanent pink. At first this reaction proceeds very slowly, so the permanganate is added a drop at a time and shaken after each drop until the solution becomes colorless. After the first few drops the reaction goes on quite rapidly. The normality of the permanganate is then calculated by the formula:

$$\text{Normality of } KMnO_4 = \frac{0.1 \times 25}{\text{c.c. } KMnO_4 \text{ used}}$$

Equation:

$$2KMnO_4 + 5Na_2C_2O_4 + 8H_2SO_4 = K_2SO_4 + 2MnSO_4 + 5Na_2SO_4 + 10CO_2 + 8H_2O.$$

The burette is next charged with the sodium thiosulphate solution. To a 250 c.c. conical flask are added in the order mentioned: 1 to 2 gm. of potassium iodide, 10 c.c. of water, 5 c.c. hydrochloric acid diluted 1:5 by volume, and 25 c.c. of the permanganate solution. As the permanganate flows into the flask, iodine is set free.

Equation: $2KMnO_4 + 10KI + 16HCl = 12KCl + 2MnCl_2 + 8H_2O + 5I_2$

This iodine is then titrated with the thiosulphate from the burette, first until it has been reduced to a pale straw color, and then, after addition of a drop of starch solution, until the complete disappearance of the blue color.

Equation:

$10Na_2S_2O_3 + 5I_2 = 10NaI + 5Na_2S_4O_6$.

The normality of the thio will be equal to that of the permanganate multiplied by

$$\frac{25}{\text{c.c. thio used.}}$$

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THE ROENTGEN DIAGNOSIS OF DUODENAL ULCER

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THE differential diagnosis of duodenal ulceration from other intra-abdominal lesions in patients with "an ulcer history" is a subject of perennial interest and debate between clinician and roentgenologist. That the problem is still in its infancy, just as our appreciation of the factors underlying the etiology of ulceration is still adolescent, will be agreed by all. As a reminder of how recent is the development of our ability to diagnose the condition, you may recall that "deformity of the bulb outline" was established as a sign of ulcer only in the year 1914, when L. G. Cole published his paper in the *Lancet*.

Of course, many previous efforts had been made to diagnose both gastric and duodenal ulcer. Schmieden and Härtel, in 1902, published a paper on roentgen examination in surgical diseases of the stomach. Hemmeter, in 1906, tried to demonstrate the site of ulceration by a residual fleck of bismuth. Reiche, in 1909, was able to demonstrate the cavity of the ulcer by the Rieger meal. And Haudek, in 1910, for the first time clearly described the typical roentgen sign of penetrating ulcer, namely, the niche. Two years later he published a paper on the radiological diagnosis of duodenal ulcer. Baron and Barsony also published a paper on that subject in 1912. To these writers and to G. Holzknecht, who did much of the pioneer work on the normal roentgen appearances of the gastro-intestinal tract, belongs the credit for the simplification, or even elucidation, of the diagnosis of peptic ulcer. Later investigators, von Bergmann, Chaoul, Akerlund, Carman, and Forssell, among others, have added considerably to our information.

Before passing on to the pathology and diagnosis of ulceration it may be entertaining to recall a few lines from Beck's textbook on "Roentgen-ray Diagnosis and Therapy," published in New York in 1904. In dealing with the roentgen examination of the abdominal region (peptic ulcer, as such, is not mentioned), he observes that the gastric outline may be mapped out by filling the viscus with salts, such as subnitrate of bismuth, or gases, such as carbonic acid and air; but states, however, that "the introduction of a soft rubber tube, the lumen of which is filled with mercury, is preferable," or the use of a rubber tube containing a spiral wire "as designed by myself."[1] "The stoppage of the tube indicates its arrival at the large curvature, and, in selected cases (especially in children), the motions of the spiral wire may be studied by the aid of the screen." (One wonders if our present methods of examination will not seem equally archaic twenty-five years hence.)

Pathologically, duodenal ulcer may be divided into various types, depending on whether one wishes to use a strictly histologic, a medical, a surgical, or a roentgenologic basis. Undoubtedly fresh mucosal erosions occur, which are easily—and probably frequently—overlooked, even at operation and autopsy, but whether such lesions produce symptoms or not, or, granted that mild symptoms may occur with them, whether they can be diagnosed by roentgen examination or not seems very doubtful. The absence of penetration prevents the demonstration of a niche, and it seems probable that any associated deformity due to submucosal infiltration or spasm of the muscularis mucosæ is slight and inconstant. Chronic duodenal ulcer is, therefore, the major problem

[1] Though actually Lindermann (Deutsch. med. Wchnschr., 1897, XVII, 266) suggested it first.

from the clinical and roentgenologic standpoints.

From the histologic viewpoint duodenal ulcers may be divided into fresh mucosal, chronic indurated, chronic penetrating, and perforating ulcers. As Kaufmann says, the microscopic findings in fresh ulcer are very slight, indeed, hardly distinguishable from artefact, so little infiltration is there. The chronic ulcers have varying degrees of peripheral mucosal thickening, submucosal infiltration, and scarring in the muscularis and peritoneal coats. When penetration involves and passes beyond the serosa (or, posteriorly, the muscularis), a perforating ulcer results; those on the anterior wall may be associated with acute peritonitis, or, if gradual, periduodenitis and adhesions; those on the posterior wall may involve the pancreas. Multiple ulcers and combinations with gastric ulcer are not rare. Stenosis by scar tissue is very rare.

From the medical point of view duodenal ulcers may be divided into the healing and the chronic types. The former are presumably mostly mucosal ulcers; the latter include painless (silent), painful, bleeding, and obstructing types. While some of the bleeding duodenal ulcers have proven to be comparatively superficial lesions, most of this group fall into the histologically chronic penetrating set, and have, therefore, the anatomical picture of such.

From the surgical viewpoint a "recognizable classification" of ulcers is a very difficult business. The individual ability of the surgeon to examine that often really quite inaccessible organ, the duodenum, is variable. Expert upper-abdominal surgeons can explore, even from the inside, the entire superior and descending portions of the duodenum, and really exclude or confirm the presence of shallow ulcer craters, whether situated on the posterior or anterior wall, but the average exploring surgeon has difficulty enough in locating the pyloric vein, to say nothing of exploring the entire bulb, front and back.[2] Hence, the report "duodenum negative" from the operating theater does not always mean that there is no duodenal ulcer—a remark that may, of course, also apply to the X-ray department, as will be subsequently considered.

Fresh mucosal ulcer is rarely recognized except when it gives rise to slight thickening; careful palpation may then discover it, and petechial stippling, following stroking of the serosa with gauze, confirm it. In all probability, such cases rarely come to operation. Chronic ulcers give rise to external scarring, with or *without* contraction and deformity. Clairmont-Meyer divides them into two types: true chronic ulcers (manifesting themselves by typical craters), and "chronic recurring ulcer-processes" (or ulcers at the sites of periodic healings, *i.e.*, flat ulcers, and ulcers with scars, or marked deformities of the bulb). Such chronic lesions are usually accompanied by a fairly stiff, infiltrated intestinal wall, with or without contraction. Perforated ulcers (acute) need not be considered in a brief roentgenologic survey.

From the X-ray viewpoint duodenal ulcers, as diagnosed, include practically only the chronic type. Most of them are small and shallow (though producing deformity in the roentgenograms far out of proportion to that found at operation, the reasons for which will be considered later); a few are perforating (with either accessory pockets, adhesions or both), and a few occur at the pyloric ring (producing obstruction). These latter may be quite small; indeed, some writers describe tiny erosions on the pyloric diaphragm, comparing them to fissures about the anal sphincter. They attribute the obstruction to spasm, rather than to edema, scar tissue, or muscle hypertrophy.

Anatomically 95 per cent of duodenal ulcers occur in the bulb, more often nearer

[2]Not that such is a matter for criticism. We all know that thorough investigation of the gastric antrum, pylorus, and bulb is a difficult enough matter even in the autopsy room.

the lesser than the greater curvature. Recent statistics suggest that they occur with equal frequency on the anterior and posterior walls, though Assmann believes them to be more common posteriorly, and Carman, from a huge experience, found them most often anteriorly. Schinz states that less than 5 per cent occur on the lesser curvature proper. Statements as to multiplicity vary; Assmann believes they are "often multiple," Schinz that 60 per cent of cases are multiple, while Carman and others believed them to be usually single. Not infrequently they occur with gastric ulcer (some say 5 per cent, some 15 per cent; Wilkie mentions over 15 per cent). The fact that other intra-abdominal lesions, such as chronic appendicitis and cholecystitis, may be associated with duodenal ulcer, and complicate the clinical or radiological picture, is well known.

Roentgen Diagnosis.—Innumerable articles, monographs, even books, have been written on this subject, listing direct and indirect signs, gastric and duodenal signs, fluoroscopic and radiographic signs, but out of all the vast welter of literature the conviction has been apparently reached that there is one main roentgen phenomenon which strongly suggests (occasionally even indicates) the presence of ulcer, and that is *deformity of the bulb.* Practically all the other signs are merely contributory to or confirmatory of this, and, by themselves, are so ambiguous that they mean little or nothing. This deformity does not need to have any particular shape; indeed, a moment's reflection on the varied factors which enter into its genesis makes one realize that a standard type of defect would be an impossibility. However, whatever type of irregularity there is should be reasonably constant and present in most of the films (or in all of the films taken from that angle which happens to bring out the defect best in each particular case).

As previously observed, most duodenal ulcers that come up for roentgen examination are of the chronic type, some with craters similar to gastric ulcers, but most of them showing "surface extension rather than depth." The usual roentgen evidence of such is a *general distortion of the bulb.* This distortion, almost always much more marked in the film than appearances at operation or autopsy suggest,[3] is now believed to be due to a combination of several factors and not to spasm of the muscular coat alone. These factors are mucous membrane swelling, spasm of the muscularis mucosæ (usually producing this swelling), infiltration or edema of the submucosa, and, sometimes, scar tissue and spasm of the muscle coats proper (either the circular or longitudinal fibers). Sometimes the mucous membrane swelling and spasm of the muscularis mucosæ occur in a purely transverse direction, when we see the classical unilateral or bilateral incisura-like defect (*annular constriction of the bulb*). Occasionally (very occasionally, in my personal experience) one can make out the niche, either *en profile,* by rotation into one or other oblique position, or *en face,* by manual pressure on the bulb, emptying it of all the barium except that which lies in the ulcer crater. The general consensus of opinion at present seems to be that it is only exceptionally that one can demonstrate the profile niche with pseudo-incisura opposite to it (statements by Akerlund and other careful workers to the contrary, notwithstanding). Occasionally in multiple lesions (?), with much spasm of the muscularis mucosæ and submucosal edema, and in very chronic ulcers with much scar tissue and adhesions, a partial stenosis of the duodenal lumen occurs, with dilatation of the proximal portion of the bulb and the formation of a diverticulum—even multiple diverticula may be formed. These, of course, are really pulsion pseudo-diverticula. The so-called accessory pocket, due to past

[3] The duodenal lumen being empty, the walls lie flat; and spasm being partly (at operation) or wholly (at autopsy) abolished, irregularities of spastic origin disappear.

perforation with extra-duodenal extension, is probably not encountered often, despite its frequent mention in the literature.

The indirect signs adduced as diagnostic of duodenal ulcer are almost innumerable. The most commonly described ones, especially in Continental literature, are permanent filling of the bulb or persistent bulb, fleeting filling of the bulb, dextroposition of the bulb with or without pyloric eccentricity, and alterations in gastric function (hyperperistalsis and stasis). Only the last two merit comment here. In a recent carefully studied series of one hundred operatively proven cases Pendergrass found gastric hyperperistalsis in 65 per cent, and a six-hour gastric residue in 60 per cent. The latter figure, as he observes, is probably high, Carman reporting it in only 25 per cent and others in less than 40 per cent. But, given an irregularity of the bulb in a patient with clinical symptoms of ulcer, the additional presence of gastric hyperperistalsis and a six-hour residue will almost always confirm the existence of duodenal ulcer. Carman's dictum was that "gastric hyperperistalsis with residue and a normal gastric outline is pathognomonic of duodenal ulcer with obstruction."

The question of pylorospasm in duodenal ulcer is one of never-ending debate. Pendergrass (*loc. cit.*) gives its occurrence as 36 per cent, which is presumably an average estimate. The facts that it seems to arise as a so-called "reflex" in so many other intra-abdominal conditions and also from mere nervousness alone, render its significance ever doubtful.

The gastric stasis in obstructing duodenal ulcer (which includes most so-called "pyloric ulcers") used to be attributed to reflex pylorospasm or, in rare cases with considerable scar-contraction, to organic stenosis of the duodenal lumen. Recently, however, Schinz and others have suggested that swelling of the mucous membrane and hypertrophy of the pylorus muscle are the factors involved, and not pylorospasm.

Fluoroscopic phenomena such as transient irregularities of the bulb, with irregular and incomplete emptying, slight gastric hyperperistalsis, local tenderness, etc., are all such indefinite findings that their significance is slight. In some cases, however, with a strongly positive clinical history including the finding of occult blood in the stool, I suppose they should be considered as suggestive of duodenal ulcer, provided the gall bladder and appendix are not inflamed. Re-examination in a short time is always desirable.

Roentgen "Misdiagnosis." — Incomplete filling of the bulb, either at fluoroscopy or in the films, is probably the most common cause for the incorrect report of duodenal ulcer. To secure complete filling is often a matter of considerable difficulty, patience and a little luck being the observer's chief recourses. Occasionally reflex spasm from extraduodenal lesions, peristaltic contractions of the bulb, or periduodenal adhesions will also lead to error in the interpretation. To distinguish them in the films alone is usually impossible, though the ulcer-distorted bulb is said to be more sharply outlined, with clear-cut projections and indentations producing the general deformity.

To prevent errors due to reflex spasm or peristaltic contractions, the use of antispasmodics, such as atropine, papaverin, and the nitrites, has been resorted to. But, in spite of their advocacy by careful workers, their usefulness is doubtful. To be of value, they must be pushed to their physiological limit, and then they are capable of relaxing the spasm even of intraduodenal lesions. Other authors use various radiolucent compression devices, to insure filling of the bulb during exposure: these, too, are open to the objection that the production of artefacts is easy. Undoubtedly the most certain way to reduce the number of errors in diagnosis is to *re-*

examine the patient. Consultation with the clinician in those cases still doubtful after re-examination would reduce the number of errors even further.[4]

As to the actual percentage of errors in diagnosis, published figures vary considerably. Of even greater interest are the reasons for these errors as shown by operation or the subsequent course of the case. Carman, in 1920, reported a series of 417 roentgenologically diagnosed duodenal ulcers; 255 of these came to operation and 246 were confirmed, leaving 9 cases incorrectly diagnosed (3.53 per cent). The findings on these 9 cases were as follows: gastric ulcer (5 cases); cholecystitis with adhesions (1 case); cholecystitis with appendicitis (1 case); carcinoma of the stomach (1 case); appendicitis (1 case). Whether or not he attributed the bulbar deformity to reflex spasm in eight of the cases, and to adhesions in the other one, we do not know. During the same interval there were 3,105 cases diagnosed as "negative": 351 of these had explorations for various reasons; 336 were confirmed as negative, and 15 proved to be incorrectly diagnosed (4.24 per cent). The findings on these 15 cases were as follows: duodenal ulcer (14 cases); gastric ulcer (1 case).

Pendergrass recently reported one hundred operatively proven duodenal ulcers, the roentgen diagnosis being incorrect in 12 cases (12 per cent). The findings on these 12 cases were as follows: 6 cases (diagnosed "probable adhesions") had ulcers of the bulb (3 "healed"); 3 cases (diagnosed "adhesions") had ulcers of the bulb (1 "healed"); 2 cases (diagnosed "uncertain") had ulcers of the bulb; 1 case (diagnosed "negative") had ulcer of second portion of the duodenum. He does not mention positive roentgen diagnoses with negative surgical findings, and hence the causation of bulbar deformity is not discussed.

The following small series of cases is mentioned almost apologetically, our principal excuse being that those cases incorrectly diagnosed by the X-ray have been chiefly studied. Out of 260 cases sent for examination, there were 46 roentgen diagnoses of duodenal ulcer. Twelve of these came to operation: eight had duodenal ulcer, three had "no ulcer," and one was "doubtful." Twenty-eight cases were clinically "definite ulcers" (history and subsequent course); three were clinically negative, and one was doubtful. Two could not be traced. Hence, of 46 roentgen diagnoses of duodenal ulcer, 36 were presumably correct, six were presumably incorrect (14 per cent), two were doubtful, and two were untraced.

The findings in the six cases were as follows: (1) Cholecystitis and appendicitis—duodenum externally negative; (2) appendicitis, chronic—"pylorus slightly thickened"; (3) inoperable carcinoma of stomach—duodenum externally negative; (4) no operation—clinically chronic cholecystitis (negative for ulcer); (5) no operation—clinically anemia, with tarry stools of unknown origin; (6) no operation—clinically anemia and dysphagia of unknown origin.

Presumably reflex spasm was the cause of the bulbar deformity in the first two cases (either of the muscularis mucosæ or of the muscularis proper); infiltration or misinterpretation of the position of the pylorus in the third; judging from the films, adhesions or spasm would account for the fourth error; adhesions or a silent duodenal ulcer for the fifth, while the etiology of the deformity in the sixth case was quite unknown.

The two doubtful cases were: (1) Duodenal ulcer or carcinoma (*sic*); death in four weeks; no autopsy: (2) no operation—clinically chronic appendicitis and menstrual irregularity.

Presumably the first case had either neo-

[4] Although the clinician, for some mysterious reason, all too often regards the reaching of a diagnosis as a sort of competition, and hesitates to express an opinion lest it might aid the wily radiologist.

plasm or ulcer; the patient was in poor condition and the operation was a very hurried affair, a rapid posterior gastro-enterostomy being done, without detailed examination. The second case had such a "classical," constant deformity of the bulb that I felt sure it was a healed duodenal ulcer.

CONCLUSIONS

While, as Köhler says, the last word on this subject has not yet been written, the scheme presented below may be of use in doubtful or atypical cases.

In cases with *positive roentgen reports but no clinical evidence* of ulcer, if there is (1) a constant, classical deformity of the Akerlund type, it is probable that the patient has a healed duodenal ulcer, with scarring of the bulb; or if there is (2) a constant "average" irregular deformity, the possibilities include healed duodenal ulcer, periduodenal adhesions, peristalsis of the bulb, or reflex spasm (due to cholecystitis, appendicitis, or gastric lesions). Broster, among others, notes that reports of duodenal ulcer not rarely turn out at operation to be gastric carcinoma, an error most commonly due to mistaking the true pylorus.

In cases with *negative roentgen findings but strongly suggestive clinical symptoms,* the absence of deformity does not exclude ulcer if the symptoms are acute or very recent; but in the presence of chronic symptoms, duodenal ulcer is definitely excluded in all likelihood.

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PERSISTENT CONGENITAL ATELECTASIS[1]

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THE teaching of roentgenology was given an important place on the program of the Second International Congress of Radiology at Stockholm, and as a teacher of undergraduate and postgraduate students I was especially interested in those sessions. For teaching purposes an easily available literature of all branches of knowledge concerning the X-ray would be ideal.

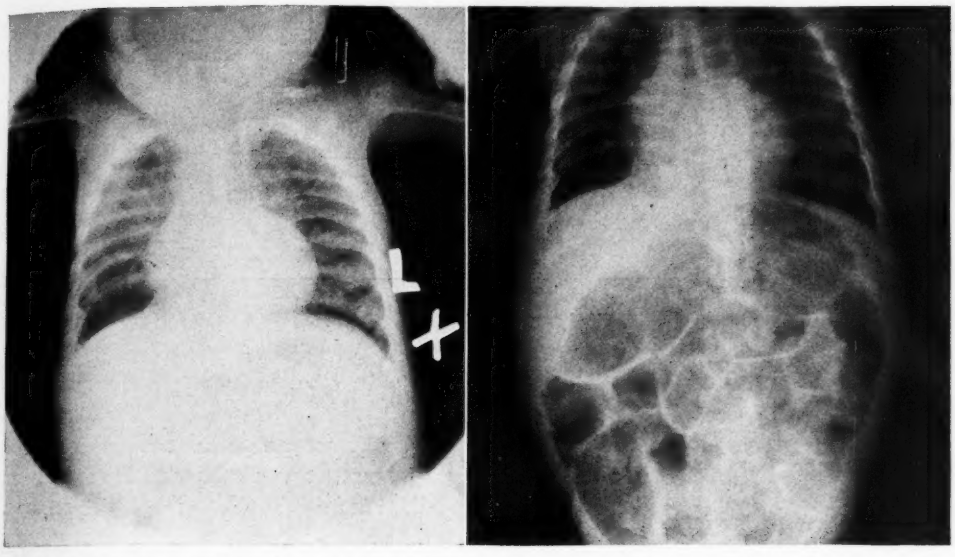
Recently I became interested in the X-ray evidence of persistent congenital atelectasis, and I wish at this time to present two cases.

Case 1 is from the service of Dr. C. G. Grulee (Hospital Case No. 238,152). This baby entered the hospital at four weeks of age, with a cold and dry cough of a week's duration. It was a premature baby which had been kept in an incubator for two weeks. The cough persisted. There was a satisfactory gain in weight. Temperature ranged from 97° to 101°. Physical examination showed no definite impairment of resonance, although fine and coarse crackling râles were heard over the base of each lung and at the angle of each scapula, posteriorly. These findings continued almost unchanged during the rest of this child's life. During the last ten days repeated attacks occurred in which the child became extremely cyanotic, with labored respiration, so that stimulants, oxygen and carbon dioxide, and artificial respiration were used. In such an attack the child died at the age of two months. The X-ray film (Fig. 1) shows a disseminated infiltration in the mesial portion of each lung, with clear periphery. The other findings are normal.

The second case is from Dr. A. H. Parmelee's service (Hospital Case No. 228,633). This was a prematurely born infant, cyanotic at birth, with cyanosis of the extremities and cyanotic attacks for ten days. It was kept in an incubator for three months, during which time it gained weight slowly. In the second three months, at home, the child gained fairly well, but the mother said there was a cough, occasional colds, once apparently a pneumonia. At six months of age the child was re-admitted to the hospital as a feeding problem. For the next three months the child's condition remained substantially the same, week after week, with alternating remissions and exacerbations of temperature—daily fluctuations of one to four degrees, often up to 102, 103, or 104 degrees. The cough persisted. There was a slowly increasing weight curve, with fairly normal digestion. On physical exam-

Fig. 1. A disseminated infiltration in the mesial portion of each lung, with clear periphery. The infant died twenty-two days after this film was taken, at the age of two months.

[1]Read before the Radiological Society of North America at the Fifteenth Annual Meeting, at Toronto, December 2–6, 1929.

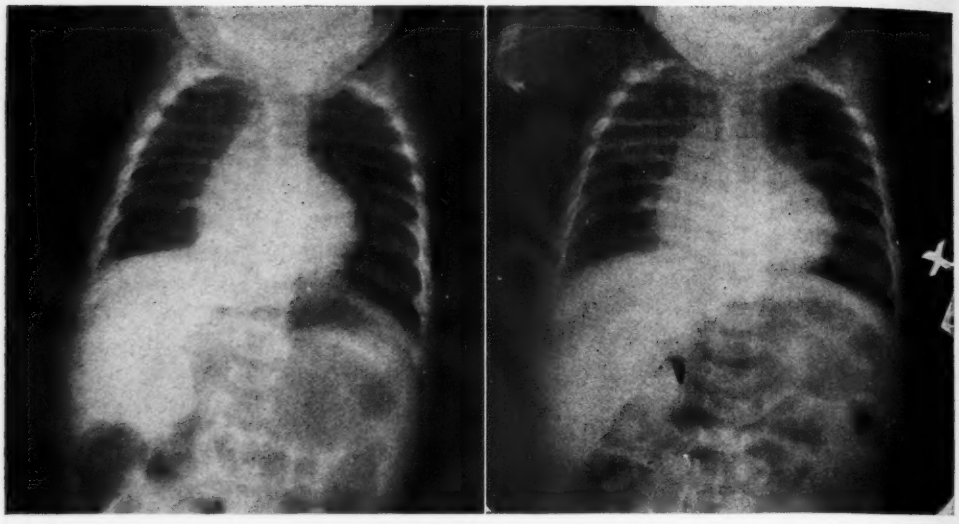


Figs. 2-*A* and 2-*B*. "A series of X-ray films covering one and a half months showed an almost identical appearance on each film, corresponding to the unchanging physical findings during this period."

ination, very little change was noted from week to week. The right lower lobe was definitely dull, with bronchial breathing and a few crepitant and subcrepitant râles. The left lung had definite bronchovesicular breathing, no râles, but a definite prolongation of the respiratory phase, and breathing was harsh. The clinical diagnosis was that of unresolved low grade bronchopneumonia. There was a terminal furunculosis and bilateral otitis media, with death at nine months of age. The terminal temperature was 107°. A series of X-ray films (Figs. 2 and 3) covering one and a half months showed an almost identical appearance on each film, corresponding to the unchanging physical findings during this period. There was considerable intensification of lung markings and small disseminated patches of consolidation, heavier near each hilum, with almost clear peripheral portion of each lung. Heart and diaphragm shadows were negative.

The postmortem examination of each of these patients was done at the Presbyterian Hospital by Dr. Carl Apfelbach. The lung findings are so similar that one description will serve for both.

The lungs were large and did not collapse when the chest was opened. The dorsal half of the right upper lobe, 90 per cent of the right lower lobe, and 75 per cent of the left lower lobe were solid. The left upper lobe was moist, with a bloody fluid. Air-containing vesicles were sparse, but were disseminated throughout. The right middle lobe contained air except for a very small area at its apex. Surfaces made by cutting were yellow-gray, mottled slightly with delicate pale red pinpoint spots and streaks. Microscopically (Figs. 4-*A* and 4-*B*) the two striking characteristics were the smallness of the alveoli and the absence of exudate in their lumens. Only about 5 per cent of the lumens were empty; in the remainder were chiefly large cells, about ten times as large as a polymorphonuclear leukocyte. These were extremely vacuolated, the nuclei small and dissimilar in shape and chromatin content, most of them excentrically placed. Also, the cells lining many of the alveoli were similarly changed by vacuoles. The



Figs. 3-*A* and 3-*B*. Continuation of series begun in Figures 2-*A* and 2-*B*. Infant died at age of nine months.

cells lining many alveoli were cuboidal in shape—the characteristic cell found in embryonal lungs. Many alveoli were rounded in shape, not compressed. The alveolar walls were thick—usually thicker than the diameter of the alveolus. Fat droplets were found in the cells lining some of the alveoli and in the cells in the lumens of some of the alveoli.

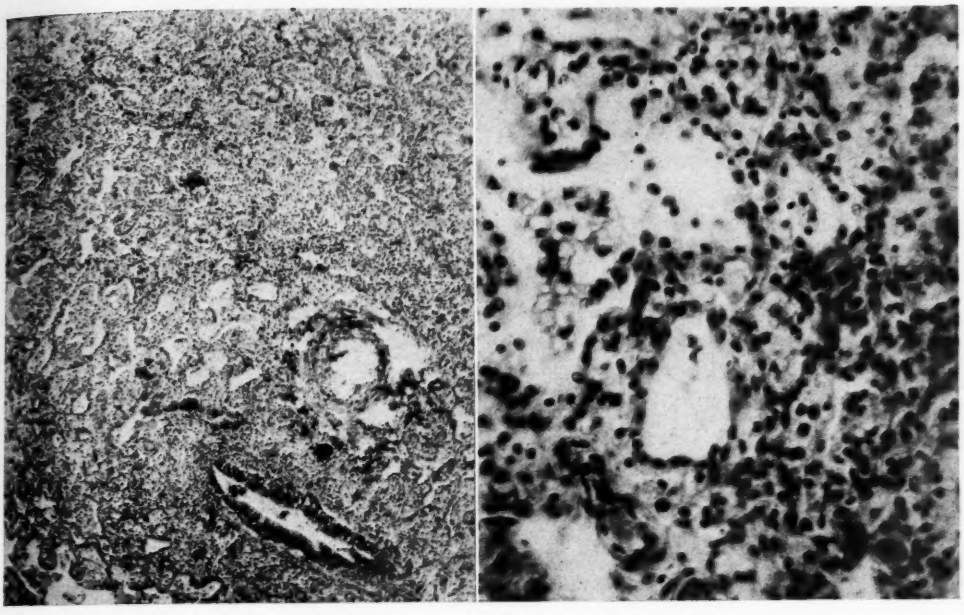
The histological diagnosis was an incomplete distention of the lungs, or a fetal atelectasis. Dr. E. R. LeCount concurred in this diagnosis.

In looking up the X-ray literature of long persistent congenital atelectasis I was surprised at its scarcity, although the condition itself is well understood and its clinical and pathological characteristics are well discussed in various places.

I was able to find only one article in the pediatric and one in the general periodical literature and two in pediatric text-books which included a description of X-ray findings in this condition. I found none in the roentgenological literature.

The earliest report of X-ray evidence was by Ruhrah, in 1919 (1), who reported a case of "congenital disseminated atelectasis, with X-ray findings and recovery." He stated as a reason for the report that at least three X-ray laboratories in Baltimore had not seen an instance of this condition. The child at four months of age was cyanotic, with respiration between fifty and eighty, had clubbing of fingers and toes and dilatation of the superficial veins of the chest. The physical signs of the heart and lungs were negative. X-ray films taken by Baetjer revealed disseminated patches of unexpanded lung, areas varying in size from pin-point to grain of wheat, scattered throughout both lungs, more numerous in the left, and more sparingly distributed in the outer portion of each lung. When the baby was two years old the clinical and X-ray findings were normal.

In 1921, Cohen (2) discussed congenital atelectasis, defined it, and gave clinical and pathological findings. His article dealt chiefly with the newborn, but he mentioned the fact that congenital atelectasis may persist for several months, as he had noted in several cases, and said that one case had been reported in which congenital atelectasis



Figs. 4-*A* and 4-*B*. "Microscopically the two striking characteristics were the smallness of the alveoli and the absence of exudate in their lumens. Only about 5 per cent of the lumens were empty; in the remainder were chiefly large cells, about ten times as large as a polymorphonuclear leukocyte. These were extremely vacuolated, the nuclei small and dissimilar in shape and chromatin content, most of them excentrically placed. Also, the cells lining many of the alveoli were similarly changed by vacuoles. The cells lining many alveoli were cuboidal in shape—the characteristic cell found in embryonal lungs. Many alveoli were rounded in shape, not compressed. The alveolar walls were thick—usually thicker than the diameter of the alveolus. Fat droplets were found in the cells lining some of the alveoli and in the cells in the lumens of some of the alveoli."

was found at autopsy in a man fifty-eight years old. Under diagnosis, he included X-ray for the differentiation between tuberculosis, thymic enlargement, and pneumonia. He stated that in atelectasis there are broad hilum shadows and irregular, ill-defined patches near the hilum, with the remainder of the lungs emphysematous. With clinical improvement the X-ray findings improve.

Standard text-books, such as Nelson's Loose Leaf, Osler, Oxford Medicine, Tice, Lord, Norris and Landis, either do not mention the subject or touch it very briefly. None mention the X-ray.

Two text-books on pediatrics give descriptions of X-ray findings in this condition. Chapin and Royster, in "Diseases of Children," discuss congenital atelectasis but do not include X-ray evidence. Morse, in "Clinical Pediatrics," discusses the condition from the physical side and states that the roentgen ray may give valuable information as to the presence or absence of atelectasis and aid in the differential diagnosis between a congenital heart lesion without a murmur and atelectasis. The films which he shows, however, were taken on the first and fourth day of life of the same baby. Holt, in "Diseases of Infancy and Childhood," gives no reference to X-ray examination in this condition. Feer, in "Diagnosis of Children's Diseases," gives one paragraph on atelectasis but no X-ray report. Porter, in "Management of the Sick Infant," discusses convulsive attacks, with atelectasis, but gives no X-ray findings. Fraser's "Childhood" and Sachs and Hausman's "Nervous and Mental Disorders from

Birth through Adolescence" do not discuss this condition. Griffith, Fischer, Dunn, and Pfaundler and Schlossmann give no X-ray reports.

Abt, in the X-ray section of his work on "Pediatrics" (3), gives one illustration of congenital atelectasis, with this sub-notation: "Note dense shadows at hilus of both right and left sides. Shadows not characteristic of any one condition. History: H. T.—Five months old, presenting symptoms of cough which had persisted for months. No history of acute respiratory infection. Physical Findings: Fair nourishment; no fever, dullness, or bronchial breathing; normal blood picture; negative von Pirquet. Persistence of symptoms and shadow over a period of five months. Diagnosed atelectasis by exclusion of other causes of consolidation." In another section of his text (II, 387) he discusses the condition of congenital atelectasis at considerable length, closing with the remark, "An X-ray examination may also be of value."

Grulee's text on "The Newborn: Diseases and Abnormalities" (4) gives this description of the X-ray findings: "X-rays may show areas of density which are impossible to differentiate from pneumonic consolidation. However, a broad shadow at the hilus and irregular patches nearby and clear peripheries is nearly diagnostic. In general, atelectasis must be differentiated from those conditions resulting in cyanosis and asphyxia."

The X-ray findings of the two cases here presented correspond to descriptions which I found in the literature of this subject.

In the differential diagnosis one should consider a chronic infiltrative process, such as a chronic bronchitis or bronchial asthma, a bronchopneumonia, and the primary tuberculin allergic reactions in tuberculosis in children.

The fact that the X-ray as well as the clinical findings remained virtually unchanged week after week was hardly to be expected in any of the other types of lesion mentioned, and should, in young children, direct attention to a persistent congenital atelectasis. With the large amount of consolidated lung found at autopsy one theoretically would expect a dense shadow on the X-ray film, such as one sees in lobar pneumonia or in acquired massive collapse of the lung.

Evidently the necessary compensatory emphysema of the non-affected portions of the lungs, together with the few air-containing alveoli in the atelectatic portions, were sufficient to obscure the consolidation to a large extent, just as a relatively small air bubble in the bowel appears black on an X-ray film of the abdomen or over a dye-filled gall bladder.

The field of the X-ray has advanced so much in the last few years that an up-to-date work, such as "The Chest in Children," which is in preparation for the "Annals of Roentgenology" series, will be of great help in diagnosis and teaching.

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DISCUSSION

Dr. W. W. Wasson (Denver): A few years ago I thought it would be very interesting to study the physiological changes which take place in the course of respiration. Accordingly, at the St. Anthony Hospital, in Denver, we placed a bedside unit in the delivery room alongside the delivery table. The infant was taken from the mother and, before the cord was cut, before the baby was spanked, it was placed on a film and a

roentgenogram made of the chest. We had a roentgenogram of the baby's lungs before any inspiration. The baby was then spanked and another roentgenogram was taken, and roentgenograms were taken every five minutes, watching the expansion of the lungs. This technic was carried out over a series of forty babies. A series of roentgenograms was made upon these babies every day during their stay in the hospital. Some of those babies have also been followed, roentgenograms having been taken at definite intervals. The result of this is that we have a roentgenographic demonstration of the physiological changes that take place from the first inspiration. Our observations have been very interesting. I had always thought that perhaps the baby automatically breathed and that immediately the lungs filled with air; but this is not the case. It is a mechanical process, and it is due to a definite stimulus, either externally or from the brain. The chest wall must raise in order that the air may go into the lungs. There must be a definite atmospheric pressure, causing the air to enter the bronchi and the alveoli. Without such a process in mechanics, the alveoli will not fill with air. This does not take place immediately, but gradually, and is dependent upon the strength of the child. We observed that frequently after a difficult labor, it took at least two weeks for the lungs to expand completely. We observed that after a hard labor, the child was unable to raise the chest walls and the lungs were slow in expanding, and when the lungs were expanded fully, the ribs were even at an exaggerated right angle on the roentgenogram. The ribs were not sloping at full inspiration—a roentgenographic sign that is very dependable. Pathologically, Dr. Rose has told you what takes place in a delayed expansion of the lungs; there is a general collapse, without round-cell infiltration; there is a collapse of the air cells. It is very readily to be seen, when one understands the mechanical progress that takes place, that it would be comparatively easy, in an unrecognized case, for the atelectasis to be prolonged through the period that Dr. Rose has reported. Personally, I have not seen a case of atelectasis after the first few weeks—we have all seen many of them during that period. The differential diagnosis might be very difficult—bronchial pneumonia, secondary circulatory disturbances, tuberculosis should be considered. Circulatory disturbances can readily be ruled out, bronchial pneumonia may be difficult, and likewise tuberculosis.

I shall report a case that came into the Children's Hospital at two weeks of age, cyanosed, no physical signs on oscultation. Radiographs of the chest showed a diffused mottling throughout both lungs, with a little stippling by hard nodules. These little nodules led us to feel that it was not bronchial pneumonia nor atelectasis. The child promptly died. A postmortem was held and when the chest wall was opened the pathologist said, "Miliary tuberculosis." But this child was two weeks of age. Slides made from the section showed no giant cells. There was calcification around the little nodules. There was also an area of necrosis surrounding the areas of calcification. This would date the infection back to intra-uterine life, and miliary tuberculosis, intra-uterine, is very rare. The giant cells and tubercle germs were not present. The only explanation we can give is that it was probably a case of intra-uterine smallpox. We have many complications to confuse us in the diagnosis of children. I think Dr. Rose's paper is a real contribution.

Dr. A. H. Rolph (Toronto): I cannot add very much to this discussion that will be of value. My experience in these cases has not been extensive, and what findings I have, have followed the lines already laid down, but I would like to report a very striking case that turned up in this connection. An infant was born in the city here

during the last year which had not had a difficult birth at all, yet for some unexplained reason, was extraordinarily cyanosed. Cyanosis was continuous and varied very little; the breathing was extremely shallow, and it was impossible to make the child cry at all; yet, in every other way, the patient appeared to be healthy. Several doctors were called in consultation in this case, and they all were pretty well agreed that it was a case of atelectasis, but were unable to explain why it should have occurred. One of them was wise enough to ask for an X-ray examination of the case, and the findings were certainly surprising. We found, not that it was atelectasis, but a very large thymus. The fact that the symptoms suggested atelectasis rather than thymus was quite interesting. The response to treatment was brilliant, and within less than twenty-four hours, the child appeared perfectly normal clinically. I wish to report this case, because it shows the extreme importance of examining these cases even when nothing such as thymus may be suspected at the time.

A POSITIVE SIGN OF EXTENSIVE DESTRUCTION OF THE MASTOID OF INFANTS[1]

By AMÉDÉE GRANGER, M.D., F.A.C.R., O. de L'I.P. (France), Professor of Radiology, Graduate School of Medicine, Tulane University; Director of Department of Radiology, Charity Hospital, NEW ORLEANS

UP to two and one-half years ago, the writer shared the opinion of other radiologists, so well and tersely expressed by Taylor (1): "In children under three years of age a radiograph of the mastoid process will yield practically no information because pneumatization has not taken place to any extent. Between the ages of three and five years some information can be obtained, because at this time the mastoid begins to assume adult form."

It is fair to assume that this is also the opinion of the otolaryngologists, since no allusion is made to the radiographic examination of the mastoid of infants in the latest authoritative work on this subject (Jackson and Coates, 2).

In May, 1927, Dr. P. H. Jones, Senior Resident Physician at the Charity Hospital, informed me that there were in the infectious wards fourteen infants, ranging in age from three months to two years, recovering from measles, bronchopneumonia, and bilateral otitis media, who were not doing as well as might be expected, and he asked if I would study radiographs of the chests and mastoids of these babies in order to assist him in determining whether a residual infection in the chest or an extension of the middle ear infection to the mastoid was the cause of their protracted convalescence.

A very careful study of the radiographs of these fourteen mastoid regions showed six of them to be unmistakably clear, and eight cloudy or opaque on one or both sides. In one of these eight cases the radiographs of both mastoids showed, besides the general opacity or cloudiness of the region, a distinct outline of the anterior wall of the lateral sinus (Fig. 1). As this outline of the sinus was not visible on any of the other twenty-six radiographs, I was interested in finding out what, if any, significance this might have.

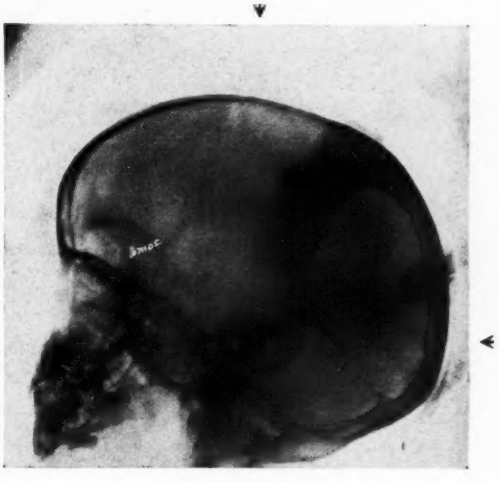

Fig. 1. Mastoid destroyed, sinus plate exposed (▼◀). Age of patient, sixteen months.

Of the eight cases in which I thought that one or both mastoids were diseased, the parents of two of the babies refused to have an operation performed. The remaining six infants were operated on and various degrees of infection and destruction of the mastoids were found, but only in that one in which the wall of the lateral sinus was visible in the radiograph, was the destruction of the mastoid so extensive that when the pus was wiped out the sinus plate (bony wall of the lateral sinus) was exposed.

Did this mean that the visualization of the wall of the sinus in the radiograph of an infant indicates extensive destruction of the mastoid, with baring of the sinus plate? Was the visualization of the wall of the

[1]Read before the Radiological Society of North America, at the Fifteenth Annual Meeting, at Toronto, Dec. 2–6, 1929.

sinus rare or possibly even abnormal in infants? And if the latter, why so?

To find the answers to these questions I made the study which furnishes the subject matter for this paper.

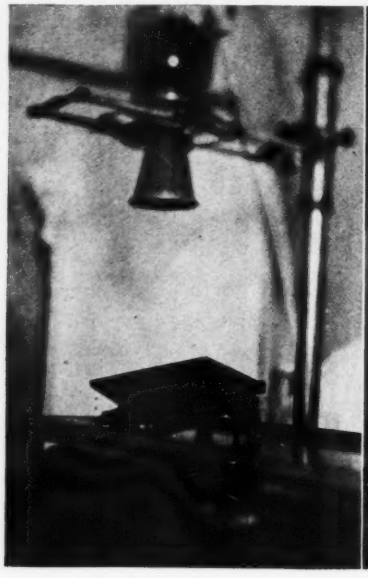

Fig. 2. An 8 × 10 film in cassette with double screen is placed on the author's double 13° angle board and the tube is centered over it.

Fig. 3. The head of the little patient is placed on the cassette and an exposure of one-tenth of a second is made.

As a first step, radiographs were made of the healthy mastoids of infants to ascertain whether or not the wall of the lateral sinus is visible in them.

There is no doubt but that the technic employed is essentially that used by those who have much of this type of work to do, but it will be described briefly for the benefit of those who, not having done much of this work, may have experienced some difficulty in obtaining not good and sharp radiographs of these little patients, because I admit frankly that in my experience this is not the rule, but fair and readable ones.

TECHNIC

An 8 × 10 film in cassette with double screen is placed on my double 13° angle board and the tube is centered over it (Fig. 2). The target plate distance should not be less than 20 inches, or twice the longest diameter of the film, in order to insure equal intensity of radiation over the entire film. The head of the little patient is then placed on the cassette as shown in Fig. 3 and an exposure of one-tenth of a second is made. This is repeated for the other side, and in this manner two radiographs—one of each mastoid in the Law position—are obtained.

Infants less than two years old are placed and held in a prone position, with the side of the head held on the cassette, as shown in Fig. 3, and as they invariably cry lustily the exposure must be so timed as to take place when they fix the head and body momentarily while they gasp for air. If the child does not cry loudly but merely whimpers or sobs, there is not much chance of obtaining even a fair radiograph without the administration of an anesthetic, and obviously this is not always practical and often

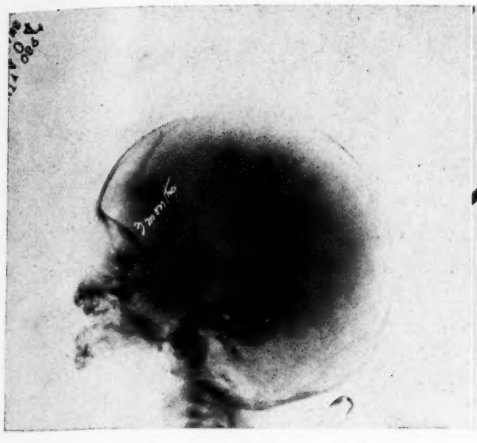

Fig. 4. Healthy mastoid. Age of patient, three months.

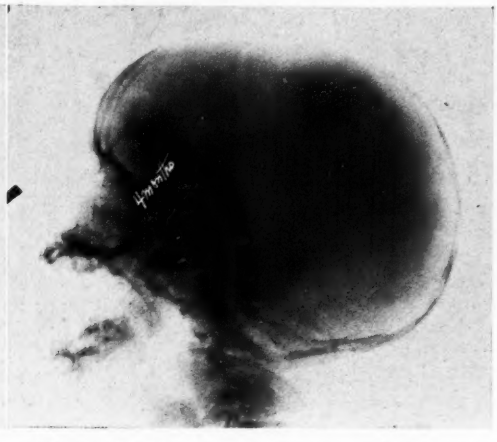

Fig. 5. Healthy mastoid. Age of patient, four months.

not desirable when the aim is to make a diagnosis.

RADIOGRAPHIC ANATOMY AND GROSS ANATOMY

In the radiographs of healthy mastoids of infants three months old (Fig. 4), four months old (Fig. 5), and six months old (Fig. 6), one sees only the large mastoid antrum; in those of infants one year (Fig. 7) and two years (Fig. 8) of age, besides the mastoid antrum, the clear osseous substance of the mastoid can be seen. After the second year and when the child reaches three years (Fig. 9), four years (Fig. 10), and five years (Fig. 11), the mastoid begins to pneumatize, the cells are of the diploëtic type, and the anterior wall of the lateral sinus—only slightly visible at first—becomes more distinct as pneumatization progresses.

The reason for what is clearly pictured in the radiograph is learned when the anatomy of the mastoid is studied.

Politzer (3) says: "The mastoid process assumes its adult type only in the third year of life. The mastoid antrum is the only

Fig. 6. Healthy mastoid. Age of patient, six months.

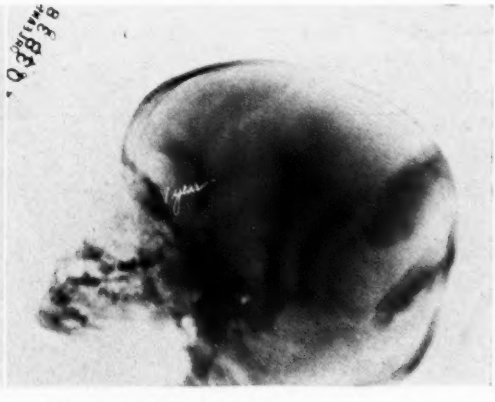

Fig. 7. Healthy mastoid. Age of patient, one year.

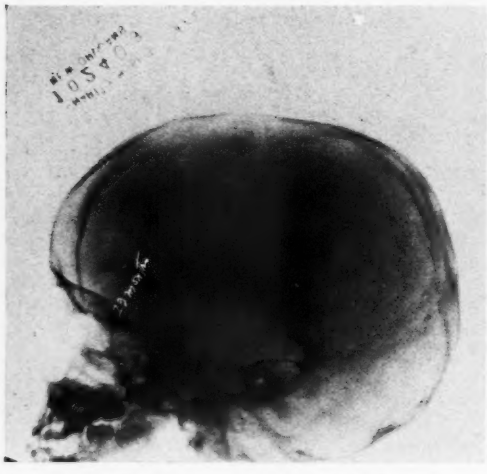

Fig. 8. Healthy mastoid. Age of patient, twenty-three months.

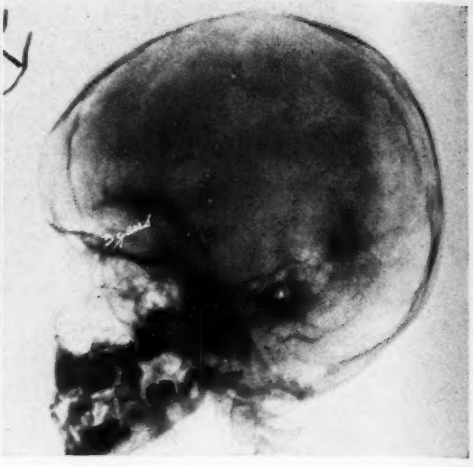

Fig. 9. Healthy mastoid. Sinus plate very faintly outlined. Age of patient, three years.

pneumatic space present in the newborn. It is a long cavity situated behind the tympanic cavity, and it is not only relatively, but absolutely, larger than in the adult."

According to Kerrison (4), "The mastoid antrum is fully developed in the newborn, even before a rudimentary mastoid can be demonstrated. It is a large space situated in the upper and anterior part of the mastoid process immediately behind the tympanic cavity; its roof is directly continuous with that of the tympanic cavity. In infants the mastoid process is composed of compact spongy osseous substance, rarely having any pneumatic cell spaces before the third year and from that time till the fifth year only small diploëtic type cells, if any."

From the foregoing radiographic and anatomic data one must conclude that in radiographs of the healthy mastoids of infants under three years—and certainly in those under two years—the sinus wall should not be seen, because the mastoid structure overlying it is too compact, and that when it is

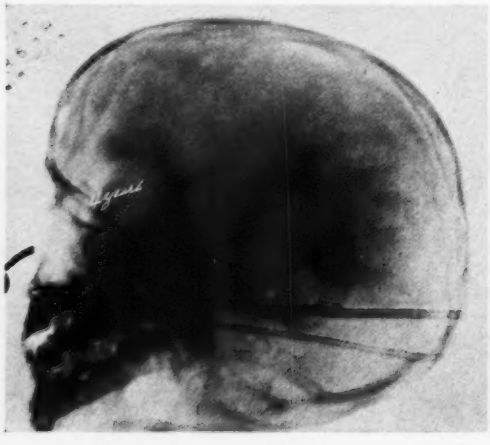

Fig. 10. Healthy mastoid. Sinus plate faintly outlined. Age of patient, four years.

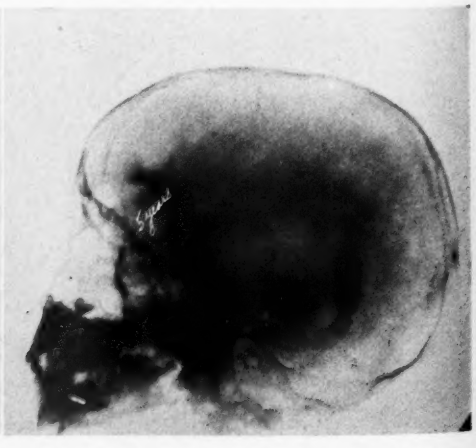

Fig. 11. Healthy mastoid. Sinus plate faintly outlined. Age of patient, five years.

Fig. 12. Mastoid antrum occluded. Age of patient, three months.

Fig. 13. Mastoid destroyed; sinus plate exposed. Age of patient, eleven months.

visible, in the absence of unusual and clear pneumatization, it can only mean extensive bone destruction. This is exactly what my experience of the last two and a half years has conclusively demonstrated. During that time I have studied the radiographs of more than two hundred infants suffering with otitis media and without mastoiditis. As a result of this study I believe that it is possible to diagnose radiographically *two degrees of mastoid pathology in infants under one year of age:*

(1) Infection with occlusion of the mastoid antrum by pus, or inflammatory or bloody exudate. The latter frequently is seen in streptohematolytic infections and is very likely to be mistaken for simple congestion unless a culture is made. In the radiograph, the mastoid antrum is opaque (Fig. 12).

(2) Extensive mastoid destruction, with the sinus plate exposed. In the radiograph, the sinus wall is visible (Fig. 13).

And three degrees of mastoid pathology in infants over one year of age:

(1) Infection, with occlusion. In the radiograph the antrum, spongy osseous structure, and cells (if any) are opaque, but the osseous structure and cell walls are still visible (Fig. 14).

(2) Infection, with occlusion and soft-

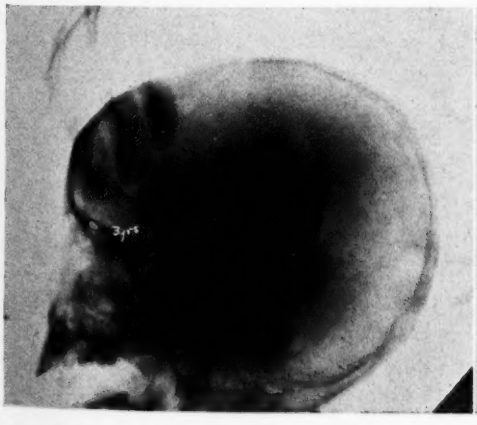

Fig. 14. Mastoid antrum occluded. Age of patient, three years.

Fig. 15. Mastoid softened; no clinical signs. Age of patient, sixteen months.

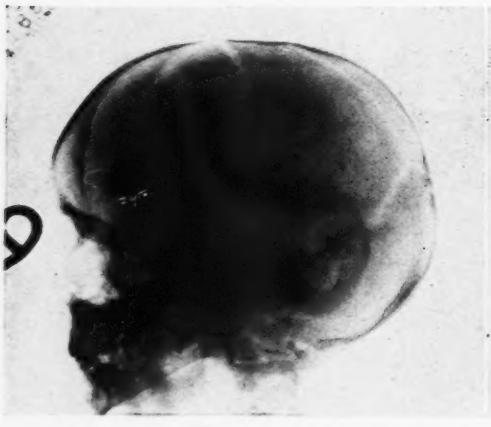

Fig. 16. Mastoid softened. Age of patient, two years.

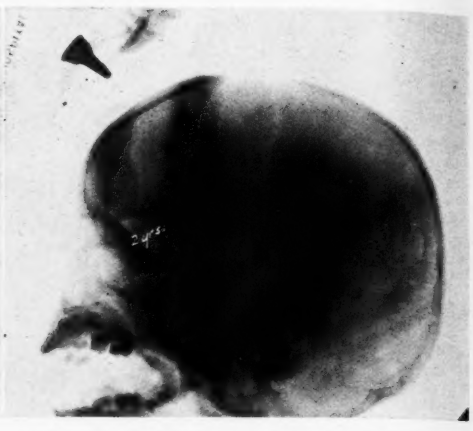

Fig. 17. Mastoid destroyed; sinus plate exposed; no clinical sign. Age of patient, two years.

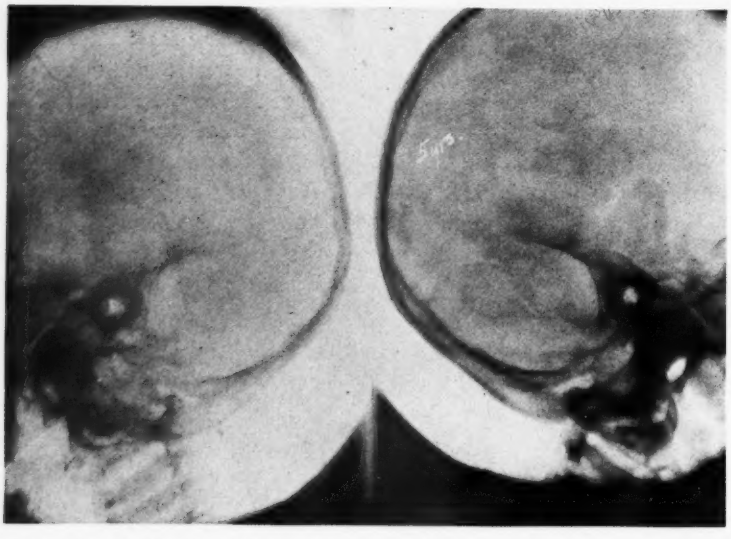

Fig. 18. Right mastoid clear; left mastoid destroyed and sinus plate exposed. Age of patient, five years.

ening of the osseous structure and cell walls (if any). In the radiograph, beside the opacity of the mastoid, the osseous structure and cell walls are no longer clearly visible (Figs. 15 and 16).

(3) Extensive mastoid destruction, with the sinus plate exposed. In the radiograph, the sinus wall is visible when it should not be (infants two years old or less) (Fig. 17). or more distinctly visible and associated with the signs of infection, with occlusion and cell wall destruction (Fig. 18).

Figure 9 is very interesting because it shows, in the same patient, the second degree of mastoid disease, infection with occlusion and softening on the left side, and

the third degree of mastoid disease, extensive destruction, with the sinus plate exposed on the right side.

During this study two important observations were also made.

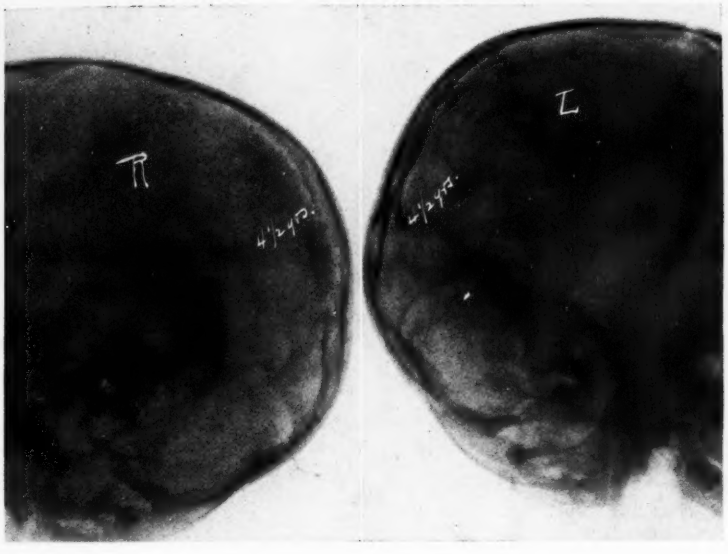

Fig. 19. Left mastoid softened; right mastoid destroyed and sinus plate exposed. Age of patient, four and one-half years.

First, in a number of cases too large to be attributed to mere hazard or coincidence, patients with definite signs of infection and occlusion but not of softening or destruction were decidedly improved by the irradiation incidental to the making of the radiographs, and went on to resolution and cure. This observation was confirmed by several competent otolaryngologists and was especially noticeable in some patients who, prior to the radiographic examination, had run a slow low grade course over a period of several days without any improvement. As a logical result of this observation, when the clinical manifestations are slight and the radiographs show no signs of softening and destruction, my colleagues of the otolaryngological specialty in both hospital and private practice institute a period of from two to five days "watchful waiting," and then, if the condition shows no sign of clearing up, or if the clinical examination indicates that it has become worse, other radiographs are made, and invariably these show signs of softening or destruction.

Second, in a number of cases—much larger than would be expected—the amount of softening or destruction revealed in the radiograph and found at operation was out of all proportion to the clinical manifestations (Figs. 15 and 17). In two such cases which occurred over two years ago, shortly after the beginning of this study, the otolaryngologists refused to operate because of insufficient clinical signs. Within a period of fifteen days from the radiographic examination one of the little patients died, from what the biopsy proved to have been a meningitis caused by the rupture of an extra-dural abscess resulting from a perforation of the tegmen mastoid, and the other developed a facial paralysis unquestionably due to the massive destruction of the mastoid, confirmed at the operation done a day or two after the paralysis had set in.

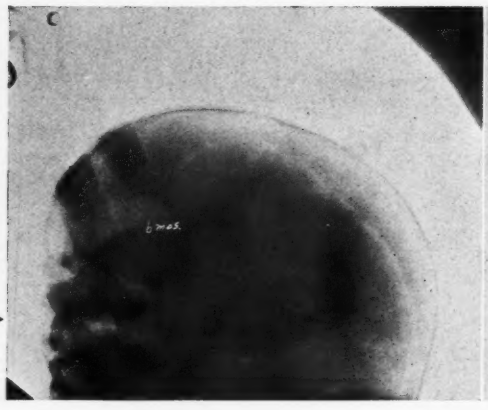

Fig. 20. Mastoid destroyed; sinus plate exposed (▶▼). Very poor radiograph. Age of patient, six months.

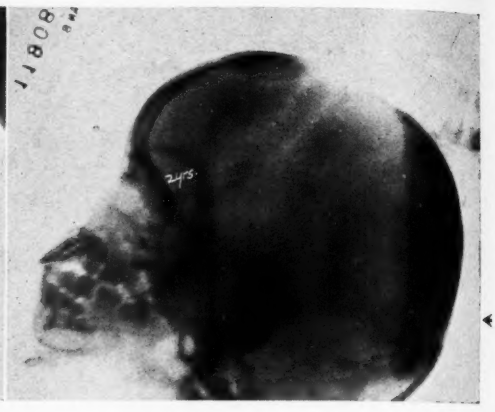

Fig. 21. Mastoid destroyed; sinus plate exposed (▼◀). Very poor radiograph. Age of patient, two years.

Another practical advantage of this sign of extensive destruction of the mastoid is that it can be read even in very poor radiographs; in fact, in radiographs in which the lesser pathological changes can not be seen at all. This is the more important when one remembers that in this work, no matter how carefully or skillfully done, a certain proportion of the results will be poor, and that not infrequently no opportunity is afforded to make other radiographs before the operation.

In conclusion, if this sign is seen, no matter how indistinctly (Fig. 20) or how blurred (Fig. 21), in the radiograph of an infant two years old or less, it means extensive destruction of the mastoid with the sinus plate exposed. And on the other hand, if it is not seen even in a poor radiograph of the mastoids of infants two years old or less, it is certain that such massive destruction of the mastoid does not exist.

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DISCUSSION

DR. GRANGER (closing): Let me remind you again that the last two radiographs you saw were shown because they were the least distinct and most blurred in my collection. Unfortunately, the slides pictured this all too truly, and I doubt if you were able to see the blurred outline of that line. I assure you, however, that we will do better with the illustrations [published herewith], and that you will be able to see in them—as I can in the original negatives—that line, blurred, but yet quite visible.

If you remember the slides of the child of five with the clear mastoid on one side and extensive disease on the other, you could see some small cells on one side and on the other side a clear space without cells but with the sinus plate visible. Whenever in the radiographs of the mastoids of a child with running ears, you get a perfectly clear mastoid without cells or osseous structure showing, be very suspicious of it, and if in it, besides, you see the outline of the sinus, there will be no doubt whatever about an active destructive process being present.

I know that you have all seen occasionally the shadow of the sinus plate in the radiographs of infants' mastoids, and that you

have thought—as I did until two and a half years ago—that sometimes you see it in children and at other times you do not. This work was done in 1927. At my hospital we see the largest number of cases of measles and bronchial pneumonia during April, May, and June. Let me repeat that this work was begun in 1927. The original observations, which were made that year, were checked during our measles and bronchial pneumonia period in 1928, and checked again this year. Therefore I feel that we can now be content that our observations are correct.

HYPOPARATHYROIDISM AS A COMPLICATION OF THYROID SURGERY[1]

By OTIS M. WALTER, M.D., CHICAGO, ILLINOIS

NO attempt will be made in this article to give a comprehensive review of the literature, as this has been done most extensively by Boothby in 1921, Biedl in 1922, Carlson in 1924, Dragstadt in 1927, and many other writers, but I will mention a few of the more salient points.

Symptoms of tetany following complete or partial thyroidectomy has been an exasperating complication of the surgical treatment of goiter. In the early surgery of the thyroid the anatomy and physiology of the thyroid and parathyroid glands were not well known, and thyroid and parathyroid deficiency were confused.

There are usually four parathyroid glands, each about 6 by 4 by 2 millimeters in size, the two superior glands being most constantly placed. They are more often found in the angle between the trachea and esophagus on the level with the cricoid cartilage, usually embedded in the meshes of the pretracheal fascia. The two inferior glands maintain a position ranging from the level of the lower third of the thyroid gland to the mediastinum. McCullom states that the two superior glands are never placed within the true capsule of the thyroid.

The subtilty of the parathyroid glands has rendered them the subject of much study and research. Sandstrom, in 1880, was the first to describe their microscopical structure, though these bodies had been previously observed by Remak and Virchow. Sandstrom at that time thought them to be undeveloped thyroid tissue, and credited them with no special physiological function. Gley, in 1891, after reviewing three hundred cases, observed that death following thyroidectomy was due in many cases to tetany. He seemed of the opinion that the tetany was due to a disturbance of the "Thyroides Surnumeriaises." Vassole and Generali, in 1896, demonstrated that the tetany was due to a disturbance of the parathyroid function. MacCallum and Vogel, in 1913, expressed the opinion that the blood of animals during tetany contained something which rendered the nervous system more irritable; during the same year they found the blood of these animals to be deficient in calcium. MacCallum had previously (in 1908) discovered that administering calcium lactate allayed the symptoms of tetany.

A number of investigators experimented with extracts of the parathyroids, with little success. It remained for Collip, in 1925, to discover the parathyroid autocoid which is capable of preventing or controlling the symptoms of parathyroid hypofunction. It is also capable of restoring to normal level the blood calcium of animals with hypocalcemia. It is well established that the parathyroids have a special physiological function, and are instrumental in maintaining a normal calcemia.

Kocher for a time enucleated the thyroid gland when treating goiter surgically. Tetany ensuing in a high percentage of these cases, this pioneer of thyroid surgery in 1881 discontinued the complete removal of the gland. There followed a lapse of many years during which surgeons resected a comparatively small portion of the struma when operating for goiter, whereupon the incidence of tetany became less. Due to the many recurrences of symptoms and the incomplete recovery of patients, surgeons have recently been removing a greater por-

[1]Read before the Radiological Society of North America at the Fourteenth Annual Meeting, at Chicago, Dec. 3–7, 1928.

tion of the thyroid gland. It is now a common practice to do a "sub-total resection," and many surgeons are enucleating the gland. As a greater amount of the struma is removed the occurrence of parathyroid hypofunction seems to be more frequent. Kocher and Haubold state that tetany may follow ligation of the thyroid vessels. The blood supply of all four parathyroids is most often derived from the inferior thyroid vessels. Therefore, it is easy to understand that the function of these glands may be disturbed by destroying the circulation in these vessels. Ligation of them is a common practice, and tetany follows but rarely; therefore, it seems that the collateral circulation supplies sufficient pabulum to maintain a normal function of the parathyroid glands. Croti has found an absence of the parathyroid glands in a considerable percentage of cases, these bodies being represented by aberrant parathyroid tissue situated in the thyroid gland. If this be true, the function of the parathyroids may be interfered with regardless of the method of resection. It is my opinion that by doing a careful dissection of the tunica propra from the surgical capsule a complete or partial resection can be done with little danger of untoward symptoms. As has been pointed out by Charles H. Mayo and Frank H. Lahey, each specimen of thyroid tissue removed should be carefully inspected and any nodules resembling parathyroids should be transplanted at once.

Recently I have had the opportunity to observe four patients suffering from parathyroid tetany, a brief abstract of whose cases will be recorded in this paper. Enucleation of the thyroid glands had previously been done in three of the cases, in the fourth a partial resection. The symptoms occurred in from two to four days after operation. The patients first complained of a peculiar tingling sensation in the fingers, soon after which a rigidity of the fingers and toes occurred. Within a few hours there was involvement of the muscles of the arms, legs, and face. If nothing was done to relieve their condition, the respiratory muscles became involved. Administering calcium intravenously relieved the symptoms within a period of one hour. Likewise the administration of parathyroid extract subcutaneously allayed the symptoms in thirty minutes. This treatment was followed by massive doses of calcium *per os*. With the exception of one case, the symptoms disappeared within a few days and have not recurred. In this one case I have found an interesting exception in that the symptoms *recur* within one week of the time calcium is discontinued.

Patients suffering from parathyroid tetany may recover; therefore, one of four things may occur: (1) the disturbed circulation may be re-established; (2) there may have been some remaining parathyroid tissue which has undergone hyperplasia; (3) the organism may adapt itself to functioning with less available calcium, and (4) other tissues may take up the work of the parathyroid glands.

CASE REPORTS

Case 1. Miss A., aged 39, entered the hospital on May 19, 1926, a complete thyroidectomy being done the following day. During the early morning of May 25th, the patient's arms became somewhat rigid. At 8:00 A. M. morphine grains ⅛ and scopolamin 1-1/100 were given hypodermically. At 9:00 A. M. there was marked rigidity of the muscles of the jaw, neck, and legs. Dyspnea was present and involuntary bowel movement occurred. At 9:15 A. M. calcium lactate grains 15 was given intravenously. The temperature at this time was 104.8. Immediate improvement occurred after the administration of calcium lactate. The blood was taken for a calcium determina-

tion, and was found to be 6-9/10 mg. per 100 cubic centimeters. The intravenous calcium therapy was repeated at 1:30 P. M. On May 26th the blood calcium was 6 mg. per 100 cubic centimeters. Intravenous calcium was again given and 30 grains of calcium lactate four times per day *per os* was instituted. The blood calcium on May 27th was 6-6/10 milligrams; on May 28th, 7 milligrams; on June 2nd, 8-5/10 milligrams. After May 26th there were no further symptoms of tetany. On June 4th, the patient left the hospital in excellent condition and has remained so until this time.

Case 2. Mrs. R., aged 44, entered the hospital on June 16, 1926, and on June 24th a complete thyroidectomy was performed. On June 27th, at 4:00 P. M., the patient complained of a peculiar tingling and drawing sensation of the fingers. During the morning of the next day, June 28th, spasms of the muscles of the hands and feet were evident. By noon of the same day twitchings of the muscles of the face appeared and the arms had become rigid. One gram of calcium lactate was given intravenously. The muscles became relaxed in 20 minutes. Diarrhea was present during the tetany. One hundred grains of calcium lactate in divided doses were given daily. Previous to the operation the blood calcium had been 11-6/10 milligrams. On June 27th it had dropped to 7-4/10 mg.; on June 28th it was 7-5/10 mg.; June 29th, 7-9/10 mg.; on June 30th, 8-4/10 milligrams. As long as the blood calcium of this patient was near 8 milligrams, no symptoms were present, but when it fell to 7 milligrams, symptoms of tetany appeared. Since her discharge from the hospital on June 30, 1926, symptoms of tetany have continued to develop at intervals. She has been instructed to continue the calcium medication, but has failed to do this regularly. For a time she reported to the office twice a week for the administration of parathormone. When the blood calcium was 7 milligrams or thereabouts, she manifested symptoms which were controlled by the administration of 2 c.c. of parathormone twice per week. In January, 1927, she discontinued coming to the office, but continued taking the calcium by mouth, when she felt the symptoms coming on. She again reported to the office on November 30, 1928, at which time her blood calcium was 8-9/10 mg. per 100 cubic centimeters. She stated that she felt symptoms the previous week, which were relieved by calcium per mouth. She appears to be well and so reports in every other respect. This obviously is a case of chronic or permanent parathyreoprival tetany.

The two other cases are so similar that they will not be reported in detail. One of these patients complained of a tingling and drawing sensation in the hands and feet, while some rigidity of the toes and fingers was evident. The other case I saw in consultation with Dr. Frederick Harvey. This patient developed tetany in 72 hours after a total thyroidectomy. At this time symptoms of parathyroid deficiency had appeared, controlled soon after by adequate doses of calcium.

DISCUSSION

PROF. A. C. IVY: Dr. Walter's paper on the complication of parathyroid tetany following removal of the thyroid is very interesting to a physiologist, because it correlates so well the laboratory findings with the clinical findings. Dr. Walter has followed closely the blood calcium in his patients, and has controlled his therapy by blood calcium determinations, which obviously is the proper thing to do. His paper teaches us, as far as the therapy of this condition is concerned, that intravenous calcium is indicated in the acute attacks when parathor-

mone is not available. Obviously, parathormone is better than intravenous calcium administration when you can obtain it, because it has no deleterious action on the kidney. Intravenous calcium does have this deleterious effect, but it will give immediate relief.

Further, the paper teaches that it is an excellent procedure to control these cases by giving calcium by mouth. Obviously, the parathormone must be administered in your office and injected subcutaneously. It is a much better procedure to teach the patient how to control the tetany by taking calcium by mouth.

Since Dr. Walter is removing practically all of the thyroid, and since we know—or it is commonly taught—that the thyroid is related to ovarian function, I would like to know whether or not this patient who has had the parathyroid deficiency now over two years has menstruated during this time.

DR. WALTER (closing): In the treatment of these patients the administration of calcium was discontinued as soon as all symptoms of parathyroid deficiency were relieved, but in the instance of Case 2, since the patient appears to have a permanent tetania parathyreopriva, 4 to 8 grams of calcium lactate administered *per os* each week are required to maintain her calcium balance.

The menstrual periods of these four patients have continued the same as they were previous to the operation. One patient had had a hysterectomy some years previous to the thyroidectomy. It is quite obvious that there has been no change in her menstrual life following the resection of her thyroid.

DIVERTICULA OF THE ESOPHAGUS[1]

By EDWARD L. JENKINSON, M.D., CHICAGO, ILLINOIS

MUCH has been written during the past twenty years regarding esophageal diverticula. Since Ludlow, in 1764, first described a diverticulum of the esophagus, many contributions have been made as to topography, classification, etiology, and treatment. In 1877, Zenker and Von Ziemissen made a careful study of the subject, classifying diverticula as of the pulsion and traction types. The literature is replete with case reports. Many writers have gone into the surgical treatment, advising and describing numerous operations. In more recent years such masters as C. H. Mayo, A. D. Bevan, A. E. Halstead, Frank H. Lahay, and E. Starr Judd have made important contributions regarding all phases of the subject. That the surgical treatment of esophageal diverticula is not altogether satisfactory is evident on reviewing the literature on the subject. Certain English writers doubt very much the good results claimed by many surgeons.

To recapitulate, a diverticulum is a pouch, or cul-de-sac, whether normal or abnormal protruding from a main cavity. There seems to be a predisposition in certain individuals to the formation or development of diverticula. It is not uncommon to find a patient with a diverticulum of the esophagus who also shows diverticula of the duodenum and colon.

Diverticula of the esophagus are usually classified into pulsion, traction, and pulsion-traction types.

According to most writers, pulsion diverticula are most common in the upper part of the esophagus, at its junction with the pharynx. There is a triangular area of muscle between the pharynx and the esophagus, supposedly weak, through which muscle diverticula are prone to occur, especially in older persons. Diverticula of the traction type are most common in the middle third of the esophagus; they usually follow some inflammatory process in the mediastinum or lungs. Adhesions form and pull the esophagus out, and a pouch develops, consisting of all the coverings of the esophagus. These traction diverticula may later develop into those of the traction-pulsion type. The internal membrane herniates through the muscle and is covered by the outer coat. These occur when the sac, becoming filled with food, dilates. According to Judd, about 7 per cent of traction diverticula assume the traction-pulsion type.

The lower third of the esophagus, in our experience, has been the commonest location for diverticula. They are usually of the pulsion type, and point downward. Diverticula of the traction type usually point outward and upward; therefore, they do not become large. Those of the pulsion type are often hard to identify if located low, as they are small and empty rapidly. Elevation of the patient's hips may be necessary to fill the sac. If pulsion diverticula are located high, they are easily identified. Morley believes goiter is often the cause of diverticula, and that muscle spasm and organic strictures are important etiologic factors.

Chevalier Jackson, from his studies with the esophagoscope, believes the failure of the cricopharyngeal muscle to relax causes herniation of the pharyngeal wall just above the cricoid. He also believes that removal of the diverticulum must be followed by dilation of the cricopharyngeal pinchcock muscle to prevent recurrence, except in the case of traction diverticula, in which the

[1]Read before the Radiological Society of North America at the Fifteenth Annual Meeting, at Toronto, Dec. 2–6, 1929.

pinchcock muscle plays no part as an etiologic factor.

T. A. Shallow, contrary to others, believes that pulsion diverticula do occur before middle age, and gives illustrations and postmortem findings in a boy eight years of age. He also tells of a doctor who had typical symptoms for forty years before being operated on at fifty-four years of age. The first case is called congenital diverticulum and the second, juvenile diverticulum. Dr. Shallow is of the opinion that the sacs may arise in an area about one-half inch below the junction of the esophagus and pharynx.

William Hill, in the *British Medical Journal* (Dec. 18, 1926), takes exception to most of the statements made regarding etiology, classification, and topography. He makes this statement: "There is probably no group of lesions in the descriptions of which so much ignorance and inaccuracy has been so frequently perpetrated and perpetuated as in those appertaining to the various etiologically, topographically, and clinically distinct types of diverticula of the pharynx and of the esophagus."

Hill does not classify diverticula as traction and pulsion of the upper esophagus. He believes the sac is pharyngeal and not esophageal. His article, referred to above, is rather trite, dealing mostly with criticism regarding location, cause, and treatment of diverticula. He maintains that the work of Killian regarding location is correct, namely, diverticula occur at the junction of the oblique with the transverse fibers of the inferior constrictor, above, not just at the upper boundary of, the esophagus. His last paragraphs, we believe, are quite true in regard to what he calls "true diverticula of the esophagus." By "true," we assume he means those low down in the esophagus. He believes, and we concur in his belief, that diverticula may cause no symptoms, and, therefore, may not be suspected, or influenced by any type of treatment, even should they be accidentally discovered. As a rule, they are inaccessible and surgery is practically impossible.

The work of E. Starr Judd on diverticula of the esophagus is a thorough contribution. He classifies diverticula as follows:

1. *Traction diverticula,* due to a pulling force acting outside the esophagus, located usually at a point where the esophagus crosses the left bronchus. The etiologic factors are as follows: Contraction of cicatrix of a healing suppurating gland, diseases of the lungs or pleura, adhesions to the thyroid, mediastinitis, and disease of the spine. This type usually produces no symptoms, and is of no surgical importance. The apex of a traction diverticulum is usually higher than the base, and no food or mucus accumulates in the sac.

2. *Traction-pulsion diverticula* have the apex lower than the base, and food may and often does accumulate in the sac. They seldom cause symptoms, but may become very large.

3. *Pulsion or pressure diverticula* are always located in the cervical region in the unsupported esophageal wall directly opposite the cricoid cartilage, due to a weak point in the musculature at the junction of the pharynx and esophagus, sometimes called the pharyngeal dimple. These sacs open posteriorly and usually to the left.

The diagnosis is usually based on the symptoms, which are as follows: Difficulty in swallowing and regurgitation of food are very common symptoms. A choking sensation may often be experienced. A gurgling noise is often heard on movement. A loss of weight is common. If the diverticulum is large, a tumor may be felt in the neck; pressure on the recurrent laryngeal nerve may cause hoarseness; coughing often causes a bulging of the sac; occasionally the sac may rupture into a bronchus.

Fluoroscopic examination is of great di-

agnostic value, while the esophagoscope is often a great aid in arriving at a diagnosis. The treatment is surgical, being as conservative as possible. The usual operations are those of Murphy (two-stage), C. H. Mayo (two-stage), Bevan (infolding of the walls by a series of purse-string sutures), and Jackson's operation, using the esophagoscope.

The complications that may follow surgery are as follows: (1) mediastinitis; (2) secondary hemorrhage; (3) insufflation pneumonia; (4) esophageal fistula, and (5) recurrence.

In reviewing the cases we have examined, there is noted a great variance of symptoms. The diagnosis usually depends upon the location of the diverticulum. One located high in the cervical region is usually diagnosed from the symptoms alone. Some cases can be diagnosed by physical findings and symptoms, while others may be found accidentally during the course of an X-ray gastro-intestinal examination. Fluoroscopically, the diagnosis is usually quite simple, even during routine examination. The sac can be seen distinctly in the oblique position, and usually in the anterior-posterior position. It is often large and extends both to the right and left of the midline, and points posteriorly. Diverticula lower down in the esophagus may give no symptoms, especially if they are pointing upward, and may be overlooked fluoroscopically if no barium enters the sac. A sac may be overlooked if it is pointing downward and if it is filled with food. In the presence of inflammation around the opening, edema may close the lumen and allow no barium to enter.

In our experience, diverticula have been most common in the middle and lower third of the esophagus, usually pointing downward, and outlined fluoroscopically. None of the cases were diagnosed prior to X-ray examination, and no symptoms could be elicited referable to the esophagus. The sacs were found accidentally, and, as a rule, were small. We have never seen a very large diverticulum in the lower third of the esophagus. We have observed traction diverticula extending forward into the chest, which were adherent and changed position with respiration. From our experience, based on some fifteen cases, we have yet to find a patient with a diverticulum of the middle or lower third of the esophagus who gives a history of difficulty in swallowing. The fact that all our cases have had small sacs may account for the negative history and symptomatology—they were discovered accidentally during the course of routine X-ray gastro-intestinal examinations. The few patients seen who have shown sacs have given no history of difficulty in swallowing. Many writers claim that diverticula of the lower esophagus cause very definite symptoms, but we believe the sac must be of considerable size and also retain food before causing any great discomfort. The cases we have seen have not retained food, as it has been difficult in many instances to keep the sac full long enough to procure good films. Of recent years, films have been made while the patients were swallowing the barium, and better results have been obtained. It seems reasonable to assume that a large diverticulum, if filled with food, could cause symptoms by pressure on the adjacent structures. The symptoms caused are not unlike those of diaphragmatic hernia. In small hernias, there are no symptoms, as a rule, while in large hernias definite symptoms are encountered. If the hernial sac is large and harbors food, cardiac and respiratory embarrassment may follow. There is also a feeling of fullness in the chest. We believe the same is true in cases of diverticula—the symptoms are in proportion to the size of the sac and its ability to retain food or inability to empty itself.

Regarding the surgical treatment of diverticula of the esophagus, we are not prepared to give an opinion as none of our

cases have been operated upon. A number of our patients with diaphragmatic hernia have been operated upon by Dr. Carl A. Hedblom, and in most instances the results have been good. The hernia was repaired through an abdominal incision, the check-up examination following operation having found the hernia repaired in all cases.

SUMMARY

Diverticula of the esophagus can be classified as (1) pulsion, (2) traction, (3) traction-pulsion.

The pulsion type may be congenital, be present at an early age, or may develop during late adult life. Symptoms are usually present, and depend upon the amount of food retained in the sac, leading to dilation of the sac, and pressure. These diverticula are most common at the junction of the pharynx and esophagus. If they are in the lower third of the esophagus, the sac is usually small and points down. They probably occur through a weak spot in the esophagus, possibly where a blood vessel passes through the muscle.

Traction type diverticula are most common in the middle third of the esophagus, following some inflammatory process in the lungs, pleura, or mediastinum. The adhesions which follow pull the esophagus outward. The sacs are usually small and the apices point upward. They usually cause no symptoms, unless they harbor food and become dilated. They may develop into the traction-pulsion type and become large, due to pressure.

Multiple diverticula of the esophagus are not common, but do occur. The cases we have seen have been located in the middle third, and range in size from five millimeters to three centimeters. They usually cause symptoms and, we believe, are of the pulsion type.

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DISCUSSION

Dr. P. M. Hickey (Ann Arbor, Mich.): I am very glad that Dr. Jenkinson called attention to the confusion which exists with regard to the classification of so-called diverticula of the upper portion. Those were first well described by Zenker, and he classified them as Zenker's diverticula of the pharynx. Last year a paper was presented on diverticula, the author of which had apparently never heard of the distinction between Zenker's diverticula of the pharynx and true diverticula of the esophagus. I think they are really hernias of the posterior wall of the pharynx. They all occur in the same type of persons—usually in individuals past sixty years of age. There is a laxity of the membrane, and the pouch is pushed down behind the esophagus, where an obstruction is produced which sometimes simulates carcinoma. We had one patient brought into the University Hospital, who was dehydrated, had lost a hundred pounds in weight, and was practically dying when she came in. An examination showed that she had Zenker's diverticulum or Zenker's hernia. It is always useful in such cases to make the lateral view to show the true position of the hernial sac behind the posterior wall of the esophagus. Diverticula of the middle and lower esophagus do not usually cause symptoms—they are usually accidental findings. The pathologists tell us they are quite common. Probably we do not see them because we usually examine our patients in the prone position, and as the patient always shows the opaque mixture, it follows down the opening and does not tend to enter the sac. The cases we have seen personally have been without symptoms. One large diverticulum we saw last month had a sac certainly as large as a silver dollar, though the patient was totally unaware that he had any disorder of his lower esophagus, and careful questioning did not bring out any symptoms which could be referred to this.

I think that Dr. Jenkinson's presentation is very thoughtful and embodies a large experience, from the number of cases which he has quoted.

Dr. C. H. Heacock (Memphis, Tenn.): There are only two previous reports in the literature of diverticula of the lower portion of the esophagus in which more than two cases are reported: these are the series of nine cases by L. A. Smith and of twenty-two cases by Barsony and Polgar. I think the fact that Dr. Jenkinson was able to report fifteen of these cases is evidence of the painstaking way in which he makes his examination.

I have seen only two cases of diverticula of the thoracic portion of the esophagus. One of these was associated with a mild cardiospasm and the other patient had no symptoms referable to the esophagus. There were three diverticula in the first patient. Only a few cases of multiple diverticula have been reported, mostly in the German literature.

In addition to the three types described by Dr. Jenkinson, Barsony and Polgar describe a fourth type which they call functional. These are small sacculations occurring in the region of a contraction during the time of the contraction. When the wave has passed, the contour of the esophagus is smooth again. They are purely functional, and usually associated with some nearby lesion, such as a duodenal ulcer. I have never seen any of this type of diverticula but wish to show some drawings taken from Barsony and Polgar [shows slides].

Dr. Lester Levyn (Buffalo, N. Y.): There seems to be considerable divergence in opinion as to whether esophageal diverticula are congenital or not. I am of the opinion that they are not a great deal different from diverticula of the intestinal tract and have rarely seen them in patients under the age of forty. There may be an hereditary tendency to some weakness at a specific point in the esophagus. I believe a few cases have been reported in children and I should like to ask Dr. Jenkinson if, in his experience, he has encountered a comparatively large number of cases in the young.

EDITORIAL

M. J. Hubeny, M.D. . . . . *Editor*
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PREVENTION OF MALPRACTICE CLAIMS

ADMISSIONS OF LIABILITY

Out of experience gained in handling malpractice claims, one of the companies carrying this form of risk recently issued a series of suggestions which, if followed by the profession generally, would aid in forestalling and in defending malpractice claims and suits. We believe these suggestions worthy of reproduction.

"Make no admissions of liability on your part. Let your responsibility be determined by legal standards."

This is the first of the four most important admonitions. The practice of plaintiffs proving malpractice cases by proof of statements made by the physician which amount to admissions of liability, is no longer a myth. The danger of this practice is that it permits a plaintiff to get his case to a jury without the necessity of calling other doctors to testify as expert witnesses. For example: In one reported case a physician was charged with negligence in the application of radium, resulting in a burn. He made the remark that the radium was on too long, and it was his fault that the patient was burned. As a matter of fact he did not himself apply the radium but only ordered it. The question of his legal liability for the acts of his assistant was undetermined. In making the statement that it was his "fault" he had no thought of determining his liability according to legal standards, and, in fact, the statement was made during his preliminary negotiations for a settlement, yet, after a trial and judgment against him, upon appeal the State Supreme Court held that the word "fault" was synonymous with "negligence," and hence the physician had admitted his own negligence, and that was sufficient to take the case to the jury without any further expert testimony for plaintiff.

In another case, a physician was treating a fractured tibia; several days later he discovered a fracture of the fibula. He stated in substance that if he had discovered and treated the fracture of the fibula in the first instance, the recovery would have been complete. We all know that under some conditions it is possible to overlook a fracture even with the exercise of more than ordinary care and skill, and certainly this physician had no thought of himself determining that he had been negligent, yet the Court in that case said: "These declarations, if made, were made by an expert assuming to treat plaintiff with ordinary skill and care, and tended to prove a want of ordinary skill and care in such treatments. This was competent evidence for the purpose offered, and . . . made such a case as entitled plaintiff to go to the jury."

Examples are too numerous to mention further, and thus it becomes a timely warning that we refrain from making any statements which can be construed as an admission of liability on our part. Let our liability be determined by legal standards and not by what we may think it to be.

COMMENT ON PRECEDING TREATMENT

In a program of education for the purpose of avoiding malpractice claims and suits, the following suggestion is surely of major importance: "Refrain from making remarks about any other doctor's work. Without doubt this is a common source of instigating malpractice litigation, and most such remarks are thoughtlessly made."

Day after day malpractice claims are prompted by such thoughtless statements as, "Well, whoever did that kind of a job on you?" Fortunately, we hope and believe that such remarks coming from any doctor regarding his predecessor's work are on the decrease. Unquestionably such remarks are most often made with no malicious intent, but the harm is done, nevertheless, and the seed of discontent is planted in that patient's mind. Moreover, the doctors who make such statements cannot be sure that such remarks may not prove a boomerang, for the patient may as suddenly jump to some third doctor who will pass a similar remark concerning the second man's work.

In the records of one of the companies engaged in the defense of a large number of malpractice claims, it is no longer a novelty for the doctors to receive letters containing statements such as the following:

> "We have had him to two other doctors since. One doctor said we had a very good case for suit. The other said we were very unfortunate to have a job done like that. Both doctors will testify in court if they have to."

Of course, in many instances, the statements were not made exactly as interpreted by the patient, and, moreover, those men of the profession who make such remarks are not always willing to back them with testimony. Nevertheless, remarks of some sort have led this patient to believe that a malpractice suit could be sustained, and, when once the suit is filed, attorneys for that plaintiff will usually see that there is medical testimony of some sort to sustain the plaintiff's case.

RELATION OF ACCURATE RECORD TO MALPRACTICE LIABILITY

The third reminder in a series designed to aid in preventing malpractice claims, calls to our attention the need of keeping accurate record of the dates and nature of all treatments rendered. This is essential to refresh one's memory of a case and to aid in the defense. Suits may arise many years after services are rendered. Of course, the value of keeping accurate records has been an important part of professional education for many years. The importance of this part of our practice in its relation to the prevention of malpractice claims has not been emphasized to any great extent. Picture the situation in a typical malpractice case.

The plaintiff is treated over a period of several months—sometimes several years. Often many more months or years elapse before suit is filed. It is not until such litigation develops that the patient gives serious thought to remembering the exact dates of certain treatments, and then, under instructions from his lawyer, he makes up a memorandum of the important events in the series of treatments and remembers as closely as possible the dates of same. If the doctor does not have accurate records, records which were made at the time that the services were rendered, then the patient's dates are just as good as the doctor's and the patient's word in court will receive just as much weight as the doctor's. Sometimes the matter of a date becomes exceedingly important in determining whether or not a defense can be made under the statute of limitations. In every case the matter of accuracy is exceedingly important, and when a doctor produces a full and accurate record of his services, which record was made in his office at the time the services were ren-

dered, it is obvious that the dates and information in such record will immediately be taken as correct, over that given by the patient from his notes and memoranda made long after the services were rendered and for the purpose of building up a malpractice case.

Too numerous are the cases in which a doctor reports a claim by some patient whom he cannot recall having treated. Possibly he saw the patient once following an accident and rendered only first aid. He received a cash payment for the visit, and hence made no record. It is that service which eventually is the basis for a malpractice suit, and without any records or anything to refresh his memory as to the service rendered that patient, what chance has the doctor of building a substantial defense? Especially in the field of X-ray and radium therapy, it is impossible to retain accurate knowledge of all factors used in rendering certain treatments, without full written records.

In the case of treating a minor, he usually has a period of a year or two after attaining majority within which to file a malpractice suit. While, of course, unusual, there are on record claims made twelve and fifteen years after the services have been rendered. What chance would there be of building a defense in such a case without records to which to refer?

A few doctors have, in fact, stated that they see too many patients each day and are too busy to keep records. Such men are deserving of no protection in malpractice claims, and in time will receive none. We heartily join in the plea for records in all cases, not alone from a business standpoint but to aid in fighting the evergrowing malpractice risk.

RADIOGRAMS IN THE DEFENSE OF MALPRACTICE CLAIMS

"The importance of X-ray in the diagnosis of any possible bone injury, and before and after reduction of fractures, cannot be over-emphasized. It is becoming increasingly difficult to defend any such cases without full X-ray records."

Such is the note of warning issued to its policy holders by one of the large companies engaged in the defense of malpractice claims and suits.

A few years ago, if a fracture, for instance, was overlooked, a defense could be made that proper measurements were made, the limb manipulated and palpated, and, in brief, that all methods of examination were used with the exception of an X-ray film or fluoroscopic examination. Possibly the doctor had no X-ray apparatus in his office and it would have been inconvenient to get the patient to such. To-day a defense of that sort would have little or no weight. The X-ray has become so universally accepted that the courts have been quick to seize upon the necessity of an X-ray examination in the diagnosis and treatment of any bone injury, and by their decisions require X-ray films both before and after the reduction of fractures, especially in a community of any size, where there is no question of an X-ray tube being available.

This is aptly illustrated by the language of the Court in the case of Taylor *v.* De Vaughn, from the District Court of Appeals of California, 266 Pac. 960, where the Court said: "Applying the rules above announced to the facts of this case, it satisfactorily appears . . . that the broken portions of the bone had lost their apposition and slipped by each other at least ten days before defendant was discharged from the case, and, as testified by several reputable surgeons, that good surgeons practising in Los Angeles County invariably use the X-ray to verify their work in reducing fractures, and particularly when reducing a fracture of the femur they take X-ray pictures from time to time thereafter until union occurs, to determine if any slipping at the fracture has occurred, and that the necessi-

ties of such cases require the use of the X-ray," the findings of the trial court have ample support in the evidence. Defendant was remiss in his duties to plaintiff, in failing to verify his work by the use of the X-ray *after he reduced the fracture,"* etc.

Probably more malpractice claims result from the treatment of fractures, dislocations, osteomyelitis and other bone injuries than from any other type of injury. The usual claim is of some deformity resulting, and it is not difficult to see that full X-ray records are the most important bit of evidence in the defense of such claims. With X-ray films taken for diagnosis, and both before and after reduction, there can be no question but that the physician or surgeon knew the exact condition with which he was confronted, and, if he did not discover the fracture, then it was not due to any failure to exercise the proper means in making his examination. On the other hand, if it is claimed that there was some negligence in the manner of treatment, then the case can be defended, at least on the basis that the physician knew the condition and exercised his best judgment in selecting methods of treatment and that whatever ill results followed were not due to any negligence but rather to conditions over which the physician had no control. Defendant's ignorance of the true condition is the real enemy in defending malpractice claims.

Formerly, taking an X-ray film to verify reduction of a fracture was solely for the patient's benefit and the matter of expense usually entered into the question. To-day such record is also for the doctor's protection, and unless there is some written record of the transaction we should avoid the mistake of merely advising an X-ray examination and allowing the patient to refuse it. That merely leaves it a question for the jury as to whether they will believe you or believe the patient, and no longer can a defense be made upon that basis. We should simply *take* X-ray films or refer the patient for X-ray examination as part of the treatment. The Court, in the case above cited, did not say that it was the practice of good surgeons to *advise* an X-ray film to verify their work in reducing a fracture. The Court said that good surgeons invariably *use* the X-ray. If such roentgen-ray film is not taken, then we should always place that responsibility upon the patient by having him sign a *written memorandum* to that effect.

IMPORTANT ANNOUNCEMENT REGARDING THE 1930 MEETING

The 1930 meeting of the Radiological Society of North America is to be in Los Angeles, California, December 1 to 5, inclusive. It is the desire of the officers to make this a memorable event, and by far the largest and best meeting of radiologists ever held on the Pacific Coast.

On account of the convention rate on the railroads permitting only three or four days' time before the meeting, and the same short stay after the meeting, followed by a return over the same route only; and because of a low Winter Tourist round trip rate, allowing six months' stay and optional routes returning, it is deemed unwise to apply for the customary convention rate.

Because of the length of the trip, it will be much more pleasant to travel at least one way in a large party. For that reason, the undersigned is again about to plan for a special train, with special accommodations and features, from Chicago to Los Angeles, with an all-expense feature and two very interesting days of sightseeing, and optional dates and routes for the return trip.

The all-expense plan, from Chicago (and intermediate points) to Los Angeles, includes all meals on train (regular $1.00 breakfasts, $1.25 luncheons, and $1.50 din-

ners in dining cars); motor trip from train back to train, with luncheon in Central Cafe in Juarez, Mexico; breakfast next day in Dominion Hotel in Globe, Ariz.; motor trip over the Apache Trail and visit to Roosevelt Dam, bath and dinner in hotel at Phoenix and bus to train. This will cost only $26.25 in addition to railroad fare.

The itinerary will be as follows:

WEDNESDAY, NOV. 26, 1930

Leave Chicago (Union Station *via* C., M., St. P. & P. R. R.) 6:30 P. M. Central standard time.

Dinner in dining car.

THURSDAY, NOV. 27, 1930

Breakfast in dining car.

Arrive Kansas City (Union Station *via* C., M., St. P. & P. R. R.) 8:00 A. M. Central standard time. Here we will be joined by members from intermediate points.

Leave Kansas City (Union Station *via* Rock Island R. R.) 8:45 A. M. Central standard time. En route across the rich agricultural prairies of Kansas and northwestern Oklahoma.

Luncheon and dinner in dining car.

FRIDAY, NOV. 28, 1930

Early morning brings us into southeastern New Mexico, through many miles of purplish sage and varicolored cacti, where every mile unfolds an untold story of man's endeavor—and sometimes defeat—through a desert of rich alluvial soil and richer verdure—wherever there is a suspicion of moisture. Continuing in a bee-line toward "the land of sunshine and warmth," our train will pause at Fort Bliss, and then onward toward El Paso, in the far western corner of the Lone Star State.

Arrive El Paso (*via* Southern Pacific Lines) 10:00 A. M. Mountain standard time.

At the station, motor cars will await us to carry us on a sightseeing trip around the city and over the International Bridge across the Rio Grande into the famous old Mexican city of Juarez. Here in this bit of sunny Spain, with its quaintly dressed people, adobe houses, and flower-decked patios, we will have luncheon at the famous and popular Central Cafe, where a Mexican dance orchestra plays throughout the day (and night).

If there should be a bull-fight, we may attend that. Late in the afternoon we will return to El Paso and board our train, after a day rich in varied and unusual experience.

Leave El Paso (*via* Southern Pacific Lines) 6:45 P. M. Mountain standard time.

Dinner in dining car.

SATURDAY, NOV. 29, 1930

Arrive Globe, Ariz. (*via* Southern Pacific Lines) 7:45 A. M. Mountain standard time.

Breakfast at Dominion Hotel, Globe.

At 9:00 A. M., in luxurious motor cars, we will start a wonderful trip over the famous Apache Trail, into "the Unknown Land" where the American Indians made their last stand against the oncoming of the paleface—where Geronimo, the Apache Chieftain, was cornered and captured. All through this district are Apache reservations, but the Apaches are now reconciled with the Great White Father, and have become good citizens and industrious workmen. For many miles our course will be along the shores of Roosevelt Lake, which was formed by the backed-up waters of the Salt River, before the famous Roosevelt Dam was constructed. We will come upon ancient cliff dwellings and learn about new discoveries and excavations now in progress, and visit Roosevelt Dam, which, as just stated, impounds the waters of Salt River, making it do much valuable work. Strange natural formations abound in this region. Luncheon will be served at Apache Inn and after a brief rest we will proceed through marvellous and thrilling scenery, reaching Phoenix about 5:00 P. M., where comfort-

able rooms with bath will await us at the Westward Ho Hotel, and dinner will be served.

The evening is left free until we leave Phoenix, Ariz. (*via* Southern Pacific Lines) at 10:00 P. M., Mountain standard time.

SUNDAY, Nov. 30, 1930

Early morning finds us in the Golden State, with orange groves and fruit orchards alongside our train, and mountains in the distance.

Breakfast in dining car.

Arrive Los Angeles, Cal. (*via* Southern Pacific Lines), 9:30 A. M. Pacific standard time.

From Monday morning, Dec. 1, to Friday afternoon, Dec. 5, we will attend the meeting of the Radiological Society of North America.

Parties from the East will join our train at Chicago. Those from west of Chicago can join us at Kansas City, while the members from Minnesota, Iowa, Missouri, and Missouri River points can join us at Kansas City also. Reservations may be made to join the party at any station at which we stop. A timecard for intermediate points may be had upon request.

Sleeping car rates from Chicago are as follows: Upper berth $21.40; lower berth $26.75; compartment $75.50 (for two); drawing room $94.00 (for two or more).

The train will be composed of standard steel sleeping cars, library-lounging-observation car (with radio), buffet club car, and the necessary diners. It will be convoyed by a thoroughly well informed railroad official.

Return trip routings are optional and may be arranged for, when, as, and by whatever route is preferred. I will be glad to help any who desire it, to arrange an itinerary. Any of the following routes may be selected:

Southern Pacific to San Francisco and Portland; Union Pacific from Portland to Seattle; C., M., St. P. & P. R. R. *electrified* service from Portland to Chicago on the "Olympian," leaving Seattle 6:15 P. M. daily and arriving in Chicago at 7:40 A. M. the third day. Or one may choose a Canadian Pacific steamship or the Great Northern to Vancouver, and the Canadian Pacific R. R. (Soo Line) to Chicago.

Southern Pacific, San Francisco to Ogden; Union Pacific to Omaha; C., M., St. P. & P. R. R. to Chicago, *via* route of "Pacific Limited," leaving San Francisco at 11:00 A. M. daily and arriving in Chicago at 7:40 A. M. the third day.

Union Pacific, from Los Angeles to Salt Lake City, thence Denver & Rio Grande or Union Pacific to Denver; Union Pacific to Omaha; C., M., St. P. & P. R. R. or any other connection to Chicago. This routing will allow a visit to Zion National Park from Salt Lake City, reaching the northern rim of Grand Canyon.

Southern Pacific to San Francisco, thence to Ogden; Denver & Rio Grande to Denver; Union Pacific to Omaha; C., M., St. P. & P. R. R. (or any of the other routes to Chicago, or other routes from Denver to Chicago).

A., T. & S. F. R. R. from Los Angeles, *via* Grand Canyon, to Chicago.

Southern Pacific Lines from Los Angeles to New Orleans, thence Ill. Central to Chicago.

Round trip Winter Tourist tickets have a return limit of six months from date of sale and stop-over privileges at all points in both directions. The rates for the direct routes going and returning will be $143.78 from Chicago, and for return through Seattle and Pacific Northwest route the rate will be $162.99 for the round trip.

Plan your 1930 vacation now, for this meeting, and write the undersigned indicating the probable number in your party and what Pullman accommodations you desire.

This is going to be one of the most enjoyable of the many trips we have made together. Ask anyone who has ever been with one of our trips.

Plans are being made for a trip to Hawaii after the meeting. Do you want to go?

Preserve this, and write to me, and I will have a railroad representative see or write you.

All aboard for Los Angeles!

Cordially and sincerely,

I. S. TROSTLER, M.D.

812 Marshall Field Annex,
Chicago

POST-GRADUATE COURSE OF THE GERMAN SOCIETY OF RADIOLOGY

A Post-graduate Course of the German Society of Radiology will take place in Vienna, June 23–28, 1930. *Topic:* "Progress in diagnosis and therapy in radiology." (Twenty diagnostic reports, five therapeutic ones.) *Place:* Institute Holzknecht. *Fee for the complete course:* 52 Austrian shillings. *Number of participants:* maximum 60. *Apply to:* Kursbüro der Wiener Medizinischen Fakultät, Vienna, VIII. Schlösselgasse 22.

LEGAL STATUS OF HOSPITAL RECORDS[1]

The Neurological Institute asked the opinion of the Academy[2] on the status of hospital records. A series of questions were formulated by the Neurological Institute, and, in view of its wider experience, the questions were forwarded to the American Medical Association.

The questions and the answers of the Bureau of Legal Medicine and Legislation of the American Medical Association are as follows:[3]

1. How much of the clinical record on ward patients is subject to subpœna by the courts? *Answer:* I know of no basis for drawing a distinction between the right of the courts to subpœna the clinical records of ward patients and the right of the courts to subpœna clinical records of private patients. The record of either class may be subpœnaed so far as such records are material and pertinent to the issues before the court. Probably this is true with respect even to records covered by the statutes forbidding the introduction of privileged communications in evidence, even though such records could not be admitted in evidence after they had been produced in court in response to the subpœna. In any event, it would be unwise for an officer of a hospital served with a subpœna commanding him to produce the records in any case to decline to respond to that subpœna and to produce the records, unless he was willing to assume the burden of determining whether such records were or were not admissible and contesting the issue, if he should be adjudged in contempt, by habeas corpus proceedings and appeals to the higher courts. The proper course in such a case, it seems to me, would be to produce the records and leave the judge to determine whether they are or are not admissible.

2. Are any of the records contained in the chart of the patient considered as given in confidence, and is such confidence protected by the courts? *Answer:* It may be stated as a general rule that where the information recorded on a chart represents a privileged communication between the physician and the patient, within the meaning of the statute governing privileged communications in the jurisdiction where the question arises, and if the patient has not expressly or by implication waived his privilege of secrecy, the record will to that extent be regarded as privileged.

[1] Reprinted by permission of the Chicago Medical Society from the *Bulletin of the Chicago Medical Society*, Feb. 1, 1930, XXXII, 19.
[2] *Bulletin* New York Academy of Medicine, January, 1930.
[3] Published with permission of the American Medical Association.

3. Are the records of private patients considered to be the property of the private physician taking care of them in the hospital, or are the records considered to be the property of the hospital? *Answer:* So far as I know, no court has passed on the ownership of the clinical records of hospital patients, either of private patients or of any other class. The matter of ownership might be governed by express agreement in any particular case, provided the agreement was entered into before the patient entered the hospital. In the absence of an express agreement it is presumably governed by the rules of the hospital; a patient entering a hospital and a physician undertaking to treat a patient in a hospital may be presumed to agree to abide by such rules when they enter the hospital premises. In the absence of an express agreement and of hospital rules, the courts would probably follow the established universal or near-universal custom with respect to the matter. That custom would, it seems to me, constitute the hospital as owner of such records as trustees for the benefit of the patient. I am by no means sure that the attending physician has any right in the records after he has discontinued attendance on the patient, unless there is some express agreement giving him that right.

4. What parts of these records are considered to be given in confidence and therefore not subject to legal review or to be used in evidence? *Answer:* Just what is intended by the phrase "legal review or to be used in evidence," is not clear. The extent to which the recorded data are protected from disclosure in court depends on the law governing privileged communications in the jurisdiction where an effort is being made to compel such disclosure.

This, of course, is a question somewhat different from the use of hospital records in evidence, a matter that involves questions of hearsay, authentication, etc., that can hardly be discussed satisfactorily within the compass of a letter.

5. Are X-ray films taken of private patients considered to be a part of the hospital record, or are they the property of the private patients? *Answer:* Roentgenograms of hospital patients taken in the course of diagnosis and treatment in the hospital are, in my judgment, a part of the hospital records, and I can see no reason for regarding them in any other way, although I know of no court decision of any court of appellate jurisdiction bearing on this point. With respect to the ownership of such records, whether taken in a hospital or elsewhere, your attention is invited to an article in the *Journal of the American Medical Association,* June 18, 1927, LXXXVIII, 1985.

NATIONAL HOSPITAL DAY

Hospitals throughout the United States and Canada are beginning plans for the tenth observance of National Hospital Day, May 12, according to information reaching Dr. J. R. Morrow, Superintendent, Bergen Pines, Oradell, N. J., Chairman of the National Hospital Day Committee of the American Hospital Association.

While some institutions which have observed the day since its start are seeking new ideas, the majority of the hospitals will have "open house," reunion of babies, inspection of departments and other features which met with such success in previous years. Some of them undoubtedly have had the same experience as a hospital which decided to omit its "baby show" one year and found that the mothers, who had gathered in larger numbers than on the previous occasion, were greatly disappointed.

That more small hospitals will observe May 12 this year than in the past is the belief of some of the members of the national committee, owing to the tribute paid to

small hospitals in rural sections by President Hoover in his endorsement of National Hospital Day.

Hospital councils in some cities focus all their attention at March and April meetings on plans for a joint observance of National Hospital Day. The Chicago Hospital Association is among those doing this at this time. This association, incidentally, already has been tendered time on two radio stations.

The national committee is in touch with large manufacturers and others using nation-wide radio "hookups," and hopes to extend the radio publicity given National Hospital Day last year. Many hospitals also are making arrangements for individual radio programs, as in the past.

Most of the hospitals conducting schools of nursing which will have a National Hospital Day program will give considerable attention to a presentation of facts about nursing education and nursing service, keeping in mind that May 12 is the anniversary of the birth of Florence Nightingale.

CHICAGO RADIOLOGICAL TECHNICIANS' ASSOCIATION

The Executive Committee of the Chicago Radiological Technicians' Association desires to call the attention of all roentgenologists employing X-ray technicians, either in their private laboratories or hospitals, also the large number of internists and surgeons having in their employ radiological technicians, to the fact that this Society has been in existence for a number of years, and has performed a most worthy service in furthering the aims of the medical profession relative to the production of high-class diagnostic radiographs.

The aim of the Association is to improve the quality of work done by radiological technicians in hospitals and private laboratories, and to keep the members in touch with the new technics which are developed from time to time by leaders in the field of radiology. Contact with those foremost in the advancement of modern technics, and with all those who are engaged in the practice of this art, is stimulating to the technician, and essential to all those who would increase their knowledge of this subject.

The Chicago Radiological Technicians' Association holds monthly meetings on the first Thursday of each month, at which papers are given covering every phase of technical procedure pertaining to X-ray work. These papers are presented by men and women prominent in X-ray work, and merit the attention of every alert technician.

The Association is placing within easy reach of all technicians opportunity for increasing their knowledge of the art, and makes possible more rapid progress than would otherwise be attainable. To take full advantage of the benefits to be derived from membership in this Association should be not only the privilege, but the duty of every technician. Regular attendance at the meetings of this Society would not only be of great help to the technician, but would help the Association to extend the scope of its work.

We ask that all members of the medical profession having an X-ray technical staff urge their X-ray technicians not only to attend these meetings, but to enroll as members in the Association, and actively take part in the affairs of this worth-while society. In addition, we also invite the roentgenologists and others interested in furthering this work to occasionally attend these meetings, and thereby give their valuable moral support to this Society of men and women who are striving to increase the efficiency of X-ray service in general. It is only by this spirit of interest and active co-operation that the aims of the Society and scientific progress of the art of radiography can be materially advanced.

Again, we ask the earnest support of all internists, surgeons, and roentgenologists in the furtherance of the good work of the Chicago Radiological Technicians' Association.

MRS. NETTIE DERBY, R.N., R.T., *Secretary*
Wesley Hospital.
AMMAYCE HUMMEL, *President*
Augustana Hospital

COMMUNICATION

In the February, 1930, number of RADIOLOGY there appeared the translation of an article by Dr. Assmann, in which stress is laid upon the *Infraclavicular Situation of Early Tuberculous Lesions.* In view of the fact that lately a good deal of discussion has been aroused by the efforts of Dr. Assmann's friends to give him entire credit for the discovery of this phenomenon, I would like to call attention to the following statement on page 378 of the *Army X-ray Manual,* which was published in November, 1918, *i.e., four years before Dr. Assmann's first publication on the subject:*

"The *early lesions of tuberculosis* generally appear in the upper lobes, and *are usually found just below the clavicle* and not necessarily above it. Frequently they occur near the apex of the axilla, and appear usually as a group of faint homogeneous shadows, indistinct in outline, varying in diameter from several millimeters to a centimeter. The pathological basis of these shadows is probably an agglomeration of tubercles surrounded by a pneumonic exudate. As these lesions progress the shadows increase in number so that they coalesce, producing a larger homogeneous shadow. . . .

"While the radiographic image varies according to the state and duration of the lesion, yet the *foregoing description represents a fairly frequent form of early tuberculosis.*

"In order to diagnose incipient tuberculosis there must exist one or a group of infiltrations as above described; to base it on the presence of strands radiating from the root of the lungs will lead to frequent error."

Dr. Assmann perhaps cannot be expected to have read the *Army X-ray Manual,* and may, therefore, believe that he first called attention to this lesion. But as long as the question of priority has been raised, I wish to set the record straight, so that the credit may go to the one to whom it actually belongs. While at the time of the original publication of the *Manual,* in 1918, the names of the contributors were omitted at the request of the X-ray Division of the Surgeon-General's Office, I am certain that I am not committing an indiscretion to-day, if I reveal the name of Dr. Harry Wessler, of New York, as the author of the section on Thoracic Viscera.

Respectfully yours,
LEOPOLD JACHES, M.D.

THE INDIANA ROENTGEN SOCIETY

The third annual meeting of the Indiana Roentgen Society was held in Indianapolis on February twenty-second. Dr. A. B. Moore, of Rochester, Minn., was the speaker. The following officers were elected: *President-elect,* Dr. L. A. Smith, Indianapolis; *Vice-president,* Dr. A. C. Holly, Attica, Ind.; *Secretary-Treasurer,* Dr. J. N. Collins, Indianapolis.

HEART BEAT STARTED BY RADIOACTIVE POTASSIUM

The potassium in the diet is the radioactive element which normally performs the vital function of starting the heart beat, it appears from experiments conducted in the

laboratory of Dr. H. B. Zwaardemaker, Professor Emeritus of Physiology at the University of Utrecht. These experiments have just been reported by Dr. Charles C. Lieb, Professor of Pharmacology at the College of Physicians and Surgeons, Columbia University, who has himself spent some time on research in Dr. Zwaardemaker's laboratory.

Earlier experiments of Dr. Zwaardemaker seem to have definitely established the fact that potassium is a radio-active element. The recent experiments have indicated that a radio-active element is essential in the initiation of the heart beat, and, therefore, an indispensable element of diet. Pursuing these studies further Dr. Lieb will investigate the pharmaceutical value of radio-active spring waters, such as those found at Saratoga Springs, Arkansas Hot Springs, the Georgia springs owned by Governor Roosevelt of New York, where infantile paralysis cases are treated, and many other famous spas throughout the country. For years it has been known that the waters of these springs were radio-active, but the active charges have been so small that leading radium authorities have considered their radio-activity a negligible quantity therapeutically.

Dr. Zwaardemaker's work, Dr. Lieb pointed out, not only indicates that the radio-activity of potassium is one-millionth to one-hundred-millionth that of radium, but that even this minute charge is essential to the maintenance of the heart beat.

"This may mean," said Dr. Lieb, "that even the very slight degree of radio-activity in the waters of famous spas is of distinct therapeutic value, although it is impossible for me to make any statement on the subject before extensive experimentation. Dr. Zwaardemaker discovered, however, that the radio-active elements uranium, polonium, thorium, and radium may replace potassium in some of the simpler processes of cell activity.

"In just what radio-active group potassium must be placed we have not determined. Probably that is the work of a physicist. But it does seem to be established that potassium gives off beta radiation. This is distinguished from alpha and gamma radiation as being in the order of the electron. Alpha radiation consists of helium atom nuclei, while gamma radiation is hard, like X-rays.

"It is apparently the electrons from potassium atoms and their ionizing power that furnish the energy necessary in initiating the heart beat, but we are not yet prepared to discuss the mechanics of the process."

Dr. Lieb explained that the experiments consisted of the perfusion of the hearts of eels and frogs. When the hearts of these animals are taken out cannulæ, or small glass tubes, are attached to the blood vessels and fluid is passed through the hearts. The fluid does not contain potassium or other radio-active elements at first, and the heart ceases to beat in from half an hour to an hour.

Potassium is then introduced into the liquid and the heart resumes its beat and continues to beat for about twenty-four hours. Similar results are obtained when, instead of potassium, another radio-active element is used. Not only does this physiological action lead to the conclusion that potassium is radio-active, but measurements on specially constructed electrometers indicate that it gives off beta radiation.—*Science Service.*

BOOK REVIEWS

ROENTGEN EXAMINATIONS OF THE INTERIOR RELIEF OF THE GASTRO-INTESTINAL TRACT. A CONTRIBUTION TO CLINICAL ROENTGENOLOGY, WITH SPECIAL REFERENCE TO INFLAMMATION, ULCER, AND CANCER. (Röntgenuntersuchungen am Innenrelief des Verdauungskanals. Ein Beitrag zur klinischen Röntgendiagnostik insbesonders von Entzündung. Geschwür und Krebs.) By H. H. BERG, Berlin. Pages 198, with 193 illustrations. Published by Georg Thieme, Leipzig, 1930. Price 27 marks, bound 29 marks.

In this monograph, Berg has given us a résumé of his work regarding the roentgenographic visualization of the interior relief of the mucous membrane in the living organism. This work is a technical and clinical development of the theory founded by Forssell. An accurate description of the technic of examination is given. The roentgenographic demonstration of the interior surfaces of tubular organs is discussed, both from a general and from a special point of view, followed by an analysis of the relief picture of the gastro-intestinal tract. Two other chapters deal with the normal and pathologic behavior of the gastro-intestinal mucosa. Then the X-ray appearance of the normal interior relief of the whole intestinal canal is shown in detail, while the following chapter is devoted to pathologic changes. In conclusion, the roentgen diagnostic and clinical findings are critically evaluated. Berg is convinced that this method should increase our diagnostic efficiency considerably. Let us hope that it does not remain a culminating achievement of a few individuals only.

The preparation of the book by the well-known publishing house is excellent, not only with regard to the reproduction of an unusually large number of illustrations but also considering the high quality of paper and print.

F. HAENISCH (Hamburg).

RADIUM IN GENERAL PRACTICE. By A. JAMES LARKIN, B.Sc., M.D., D.N.B., Radium Consultant of Staffs of Wesley Memorial, German Evangelical Deaconess, John B. Murphy, Washington Park Community Hospitals, Chicago, and St. Francis Hospital, Evanston, Illinois; Instructor in Dermatology (Radium), Northwestern University Medical College. Published by Paul B. Hoeber, Inc., New York, 1929. Pp. 304. Price $6.00.

"Radium in General Practice" is a very notable addition to the few books extant on radium therapy. This volume has several points that are of interest. The author states that one of his main objects is "to make available to the general practitioner the elements of radium therapy in the daily practice of medicine in such form that he may quickly refer to the therapeutic possibilities of radium in any particular disease and weigh its value in comparison with other available methods." This object is well achieved. He states certain points which modern radiologists thoroughly agree with, for instance, that no undiagnosed lesion should be treated with radium save for therapeutic tests which may be made after determining the malignancy of the lesion without necessarily knowing the exact cell structure. Secondly, he states that "necrosis of malignant cells only or inhibition sufficient to enable the bodily resistance to overcome the invasion seems to be the goal now sought, in contrast to the old methods of 'cautery destruction' used in the early days of irradiation." A very important feature is that the contra-indications for radium therapy are thoroughly stated and emphasized. Exhaustive technical discussion

is avoided but a safe technic is outlined to make the treatments understandable.

The work takes up a discussion of general diseases such as Banti's disease, Hodgkin's disease, gynecological diseases, miscellaneous tumors, carcinomata, skin lesions, and miscellaneous conditions. Under each disease the pathology is discussed, the indications for radium treatment outlined, the method of application reviewed, the reaction from treatment discussed, and, finally, the prognosis is outlined. A typical case, considering the history, technic, and result, is cited with each disease. A very generous bibliography of current literature from the important radiological journals is appended. The book is concise, and Dr. Larkin's style is pleasing and quite readable.

MASTOIDS ROENTGENOLOGICALLY CONSIDERED. (Second Edition, Revised.) ANNALS OF ROENTGENOLOGY, Volume I. By FREDERICK M. LAW, M.D., Roentgenologist, Manhattan Eye, Ear, Nose and Throat Hospital, New York. Published by Paul B. Hoeber, Inc., New York, 1929. Price $12.00.

The second edition of this most excellent treatise has been rewritten and the subject matter brought up to date. A number of new case reports and new illustrations have been added to amplify the value of the atlas as a teaching guide in the interpretation of mastoid roentgenograms. Among the innovations are included evidence of the reformation of destroyed mastoid cells, data concerning the development of the mastoid, the infantile mastoid, demonstration of the superior petrosal sinus, foreign body in the ear, demonstration of the semicircular canals and cochlea, a discussion of the value of stereoscopic films for diagnosis, the application of lipiodol to oto-roentgenology, and lastly a unique but important use of mastoid roentgenograms for purposes of identification. In this edition half-tone reproductions are used instead of photographic plates and the number has been increased from twenty-one to thirty-five. The Spanish and French translations of the captions have been omitted.

THE NECK. ANNALS OF ROENTGENOLOGY, Volume IX. By PERCY D. HAY, JR., M.D., Roentgenologist of the McLeod Infirmary, Florence, S. C.; Former Resident Roentgenologist of the Hospital of the University of Pennsylvania. Introduction by HENRY K. PANCOAST, M.D., Professor of Roentgenology, University of Pennsylvania, Philadelphia. Published by Paul B. Hoeber, Inc., New York, 1930. Pp. 104. Price $8.00.

The author presents a roentgenologic study of normal and abnormal soft tissues of the neck, together with the indications and potentialities of this examination. The text is illustrated by sixty-six excellent roentgenograms, which will be of interest to all roentgenologists and laryngologists.

The necessity for a roentgenologic examination of the neck in the search for foreign bodies, salivary calculi, esophageal diverticula, and newgrowths is obvious, but few realize that it is the most accurate means of diagnosing retropharyngeal and retrotracheal abscesses. In addition, much valuable information can be gained regarding newgrowths of the tongue, pharynx, and larynx, specific infections of the larynx, diphtheritic stenosis, and many other conditions which are discussed in detail in the text.

The author's accomplishment in the differentiation of soft tissue structures should serve to stimulate an interest in the roentgenographic demonstration of soft tissues in general, which offers many interesting possibilities and is as yet a field virtually untouched by the roentgenologist.

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BLOOD CHANGES

Light and Carbohydrate Metabolism. Alfred Gigon. Strahlentherapie, 1929, XXXIV, 592.

The author briefly reports in this paper some of his experiments dealing with the biological action of infra-red rays. If he fed glucose to rabbits *per os*, the total carbon content of the blood was definitely increased, much more than the blood sugar. However, if the rabbits were kept in a chamber under infra-red light and received glucose for five weeks, a hyperglycemia followed, just the same as in the animals remaining in daylight, but there was hardly any change in the carbon content of the blood. Different tissues showed a different transparency for infra-red rays; while lung tissue absorbed them completely, muscle of man and rabbits is very transparent.

Since it was also observed that the feeding of glucose increased the carbon content of the red blood corpuscles while insulin injection decreased it, the author tested the transparency of blood for infra-red rays. In accordance with his previous investigations, he found that, following glucose feeding, the infra-red rays were absorbed greatly; following insulin injection, the blood became more transparent. The liver showed an inverse reaction. Blood tests in various diseases revealed quite a difference in the transparency for infra-red rays. The clinical possibilities of these observations, both from diagnostic and therapeutic standpoints, are also discussed.

E. A. Pohle, M.D., Ph.D.

Deep X-rays and the Cells of the Blood. J. H. Douglas Webster. Brit. Med. Jour., April 20, 1929, No. 3,563, p. 744.

Not only are good results obtained by radiation in some acute skin infections, but also many deeper acute and chronic infections have been successfully treated by radiotherapy. It is not the quality of the radiation used, but the quantity absorbed that is of importance to the result. Heidenhain and Fried show that radiation, to be successful in acute septic conditions, must not only be very closely watched twice daily in its effect, but must be very carefully applied—in doses about 20 per cent of the mild skin dose.

Wallace D. Mackenzie, M.D.

BONE (DIAGNOSIS)

Developmental Diseases of Bones. Samuel W. Boorstein. Med. Jour. and Rec., Jan. 1 and 15, 1930, CXXXI, No. 1, p. 17, and No. 2, p. 77.

This paper (in two parts) discusses, for the general practitioner, a group of developmental diseases of the adolescent period, including the following: Osteochondritis deformans juvenilis (Legg-Perthes' disease); apophysitis of the tibial tubercle (Osgood-Schlatter's disease); tarsal scaphoiditis (Koehler's disease); apophysitis of os calcis; osteochondritis of the spine (Scheuerman's kyphosis dorsalis juvenilis); metatarsal epiphysitis (Mouchet); osteochondritis of the second and third metatarsals (Heitzner, Freiberg); osteochondritis of the shoulder and other joints. The author discusses the etiology, symptoms, and treatment of each of these conditions, with illustrative case reports and roentgenograms of the various conditions. They occur usually at times of maximum development of the epiphysis. The onset is insidious, with mild symptoms, as a rule; the diagnosis depends almost entirely upon the roentgenographic findings. The principle of treatment is to relieve pull on the attached muscles during the acute stage, followed by massage and exercise when these symptoms subside.

W. W. Watkins, M.D.

Epiphysitis of Adolescents, with Special Reference to Etiology. Lester A. Smith. Am. Jour. Roentgenol. and Rad. Ther., August, 1929, XXII, 127.

Due to the paucity of either biopsy or necropsy studies in cases of epiphysitis, the etiology of this group of diseases remains uncertain. From a consideration of the histories

and roentgen findings in nine cases Smith concludes that infection is the commonest causative factor, while trauma is undoubtedly a secondary factor contributing to the interference of the local mechanism of resistance in the involved epiphysis. Several cases of silent epiphyseal lesions are reported.

J. E. HABBE, M.D.

Osteitis Fibrosa and Allied Diseases of Bone (The Osseous Dystrophies). L. H. Garland. Am. Jour. Roentgenol. and Rad. Ther., December, 1929, XXII, 517.

The author discusses the close similarity and conflicting theories of etiology of osteomalacia, osteitis fibrosa cystica, and osteitis deformans, the latter two conditions resembling one another very closely, both histologically and microscopically, and differing chiefly in response to therapy, osteitis fibrosa cystica often responding to surgery or the X-ray, and osteitis deformans being resistant to any known form of treatment. The author would classify all cases of osteitis fibrosa into (1) those where porosis predominates, such as the generalized von Recklinghausen's disease, the localized central fibromas, and solitary and multilocular bone cysts, and (2) those where hyperostosis predominates, including Paget's and the monosteal osteitis deformans.

J. E. HABBE, M.D.

Primary Hemangioma of Bone, with Special Reference to Roentgenologic Diagnosis. Paul C. Bucy and Charles S. Capp. Am. Jour. Roentgenol. and Rad. Ther., January, 1930, XXIII, 1.

A review is made of eight cases of primary bone hemangiomas, five having been previously reported to the Bone Sarcoma Registry. The majority of cases occurred between the ages of 30 and 50, although the extreme limits were 4 and 76. Vertebræ are involved most commonly, with the skull bones being next in frequency. Two types of roentgenologic findings are seen; in flat bones "sunburst" trabeculations are seen to radiate from a single primary center. The periosteum may be elevated but is not broken through. In cylindrical bones the tumor has a loculated appearance, somewhat resembling giant-cell tumor, but the cortex is eroded in hemangiomas, while in giant-cell tumors it may be thinned but is also expanded. Symptoms often occur only after trauma, but the etiology does not seem to be traumatic. Local excision is usually more effective than radiation, although several cases apparently have been cured by X-ray treatments.

J. E. HABBE, M.D.

A Review of the Roentgen Findings of Bone Diseases of Childhood. Preston M. Hickey. New Orleans Med. and Surg. Jour., February, 1930, LXXXII, 515.

The student of the roentgenologic plates of childhood must have a familiarity with the roentgen appearance of the developing skeleton, as it varies at different ages. No one should rashly express diagnostic conclusions in this field unless he has the proper background to fit him to put forth diagnoses based upon roentgen evidence. A number of films illustrate the roentgen findings in bone disease of childhood, both congenital and those due to endocrine disturbances and trauma.

W. W. WATKINS, M.D.

Ossifications of the Costal Cartilages: Their Relation to Habitus and Disease. Frank Riebel. Am. Jour. Roentgenol. and Rad. Ther., January, 1929, XXI, 44.

Ossifications of the costal cartilages of 541 cases were studied and the results analyzed in an effort to determine their significance, if any. No relationship with tuberculosis, either as a factor of causation or as a result, could be shown, although ossification did apparently occur more frequently in older syphilitics.

J. E. HABBE, M.D.

The Abscess of Pott's Disease. Ralph K. Ghormley. Am. Jour. Roentgenol. and Rad. Ther., December, 1929, XXII, 509.

Too often the roentgenologic investigation of Pott's disease stops with the demonstration of the destructive changes in the spine while investigation of the abscess is overlooked, yet the X-ray evidence of type, size, and course

of the abscess is, in the opinion of the author, of great prognostic value. Abscesses in the thoracic region are classified as fusiform, pyramidal, or glandular. Due to the strong anterior longitudinal and lateral ligaments, dorsal abscesses are apt to dissect beneath the periosteum for a considerable distance upward or downward, and with the transmitted pulsation from the overlying aorta the combined effects of pulsatile pressure and actual inflammation, the lateral view is apt to disclose erosion of the anterior bodies of all of the vertebræ involved by the abscess. Such a case is apt to result in extensive deformity, while with the globular form of abscess fewer vertebræ are involved and the ultimate prognosis seems better.

The lumbar abscess, in contradistinction to the dorsal, early dissects away from the spine and follows the sheath of the iliopsoas muscle.

Abscess shadows may disappear either spontaneously or when evacuated, may increase or decrease in size, or may show calcification in their walls. Dorsal abscesses, because of their dissecting tendencies, are more apt to produce extensive deformities, while lumbar abscesses, because of their likelihood of secondary infection, constitute a great hazard to life.

J. E. Habbe, M.D.

Tumors of Bone: Clinical Course—Differential Diagnosis. Dean Lewis. New Eng. Jour. Med., Jan. 2, 1930, CCII, 11.

In fibroma osteitis and central giant-cell sarcoma of bone, the diagnosis can usually be made by the X-ray. The lesion is most frequently found on the shaft side of the epiphyseal cartilage—the metaphysis. The bone is expanded symmetrically and the swelling is fusiform, extending down on the shaft. The shadow is lobulated, as the fibrous tissue is divided off by trabeculæ of bone. The lesions are benign and diagnosis by X-ray is very important, as definite, conservative, surgical procedures can then be employed.

In periosteal sarcoma, when arising from the fibrous layer of periosteum, there is erosion of bone. When the tumor arises from the cambium, there is osteogenesis, with accompanying destruction of the cortical bone. The X-ray examination shows bone destruction associated with bone formation.

In Ewing's tumor, there is relatively little medullary change in the early stages, though there may be some expansion of the shaft, with periosteal reaction. In its later course a considerable portion of the shaft may be affected, the tumor growing apparently without much resistance parallel to the long axis of the bone. At times it seems to infiltrate rather than destroy the bone.

Although the X-ray has contributed much to the differential diagnosis of bone lesions, there is as much need as ever of a good clinical history, and correlation of the clinical and X-ray findings.

W. Warner Watkins, M.D.

BONE TUMORS (THERAPY)

Roentgen Therapy of Bone Tumors. J. Borak. Strahlentherapie, 1929, XXXIII, 435.

The author recommends a dose of 600 r effective in the tumor and applied over a period of from three to six days; this treatment may be repeated after six weeks. Additional therapy did not seem to improve the results materially. It is emphasized that metastatic carcinoma in the bones responds exceedingly well to roentgen therapy. A number of case histories, with roentgenograms of the tumors before and after treatment, must be looked up in the original.

E. A. Pohle, M.D., Ph.D.

Permanent Cure of a Sarcoma of the Tibia by Roentgen Treatment Followed by Atrophy of the Irradiated Muscles. Matthias Hirschberg. Strahlentherapie, 1929, XXXIV, 421.

The history of a girl of nine years of age is related, who had a sarcoma of the left tibia, diagnosed clinically and on the roentgenogram. The parents refused amputation and roentgen therapy was, therefore, instituted. Beginning in December, 1918, several series of X-ray treatments were given, the last in July,

1919 (spark gap 38 cm., 2 ma., zinc and aluminum filter). In December, 1919, the tumor had disappeared. The left lower thigh was thinner than the right thigh, and the skin over the anterior tibial region was pigmented. About three and a half years later, the patient reported that telangiectasis had appeared over the anterior lower thigh and that the leg was considerably thinner than the right. In July, 1929, the circumference of the left lower thigh was 5 cm. less than that of the right. The skin over the anterior left tibial region showed the typical pigmentation, atrophy, and telangiectasis of a late reaction. There were no signs of recurrence.

A boy of eight years of age was treated, in 1912, for trichophytosis, over five fields (16 cm. to 18 cm. spark gap, 2 ma., no filter). Fourteen days after the treatment, the hair began to fall out but regrew promptly. In one area in the neck only the regrowth was sparse, and below the hair margin in the neck telangiectasis developed later. In 1928, the muscles of the posterior neck region had developed atrophy which could not be explained clinically. The author, therefore, diagnoses it as a late atrophy following roentgen irradiation with a relatively small dose. In both reported cases, the muscles had been exposed during childhood; the late atrophy developed not earlier than after ten and fifteen years, respectively.

E. A. POHLE, M.D., PH.D.

CANCER (THERAPY)

A Study of Five Hundred Breast Cases with Surgical End-results. W. O. Floyd and W. D. Haggard. Jour. Tenn. St. Med. Assn., January, 1930, XXIII, 24.

In 1922 a report was made of 255 cases of breast tumor, of which 126 were malignant. During the past seven years, 245 additional cases have been seen, of which 92 were malignant. In the first group 111 patients have been traced, showing 45.7 per cent of five- to ten-year cures of breast carcinoma. Out of 70 patients operated upon in the second group, 49 per cent were symptomatically well at the end of three years. Out of the total 145 patients operated upon, 53.1 per cent were well at the end of three years, 43.5 per cent at the end of five years, and 35.2 per cent at the end of ten years. Like Harrington, these authors have not found that pre-operative or post-operative irradiation has increased the percentage of cures, although they call attention to the fact that the cases having the most extensive involvement are the ones referred for post-operative irradiation.

W. W. WATKINS, M.D.

The Main Problem in the Combat against Uterine Carcinoma. Rud. Th. v. Jaschke. Strahlentherapie, 1930, XXXV, 47.

The percentage of cures in uterine carcinoma can be raised only by a better co-operation of the general practitioner and by a thorough education of the public. While it is true only too often that the majority of women come to the physician's office many months after the onset of the first symptoms, statistics set forth by the author show that a considerable percentage is referred too late to the proper place for adequate treatment. The importance of careful pelvic examination in any woman complaining of symptoms within the genital tract is stressed.

E. A. POHLE, M.D., PH.D.

Roentgenological Studies of Carcinoma. Second Communication: Cytology and Histology of Tumors after Repeated Irradiation. P. Seulberger, W. Schmidt, and F. Kröning. Strahlentherapie, 1929, XXXIV, 247.

The authors studied systematically the effect of one single dose or several small doses of roentgen rays (20 E.D. to 60 E.D.) on malignant tumors. Biopsies were done before irradiation and then at certain intervals afterwards. The report is based on fifteen cases of advanced carcinoma in man, six of the cases being described in detail. The lesions were either in the face or neck. In such an investigation, the following factors have to be considered: normal and atypical mitosis, pyknosis, autolysis, cornification, edema, hyperemia, round-cell infiltration, and reaction

of connective tissue. The regressive processes following irradiation were different in the individual cases; most interesting was the observation of an effect of the small doses which sometimes equaled that of the massive dose. While it is probably true that morphological studies of tumors can not form the only basis for outlining the treatment of malignant tumors, they offer much valuable information.

The article is well illustrated by a series of macroscopic photographs and numerous photomicrograms.

E. A. POHLE, M.D., PH.D.

Intrinsic Cancer of the Larynx: The Lasting Cure in 76 per cent of Cases by Laryngofissure. Sir St. Clair Thomson. Jour. Can. Med. Assn., July, 1929, XXI, 4.

This paper analyzes the results of seventy operations on intrinsic cancer of the larynx, through a laryngofissure. The results are striking. Thirty-four patients are alive and well, from one one-half to eight one-half years after operation. Eighteen have died from other causes, without recurrence of the cancer. Seven died from malignant disease elsewhere, and eleven from local recurrence of the cancer. The conclusion is that if intrinsic cancer of the larynx is diagnosed early, it is best operated on by laryngofissure, an operation which should be free from danger to life and followed by an adequate voice and a lasting cure.

L. J. CARTER, M.D.

Histochemical Studies on Carcinoma before and after Irradiation. Ludwig Schoenholz and Hermann Hirsch. Strahlentherapie, 1929, XXXIV, 273.

The calcium content in carcinoma of the cervix was studied before and after irradiation. The technic of the method is not given in detail, but the authors refer to a paper by Schulz-Brauns (*Virch. Arch.*, 1929). It appeared that two days after the exposure, the calcium content of the carcinoma cells was definitely increased, while at the same time there were no characteristic histochemical changes of the cells detectable by the customary staining methods. This observation is interpreted as proof of the direct effect of radiation on the carcinoma cells, independent of the reaction in the connective tissue; the latter also shows an increase in the calcium content.

E. A. POHLE, M.D., PH.D.

Carcinoma of the Tongue Cured for Six Years by Roentgen Rays. G. Schulte. Strahlentherapie, 1929, XXXIV, 541.

The history of a male patient forty-six years of age is related, who had an advanced carcinoma of the tongue involving the floor of the mouth, with metastases to the regional glands. The neck was surrounded by radioplastin (paraffin wax preparation). On three successive days, one anterior and two lateral fields (1 E.D. each) were treated. The patient had a rather violent reaction. A small piece of the tumor which came off was examined microscopically and diagnosed carcinoma. Five months after the treatment, the patient developed metastases over the left sternoclavicular region and also in the glands on both sides of the neck. As much pathological tissue as possible was removed surgically, followed by X-ray therapy with the same dose as before. Two months later, all remaining glands had disappeared. One year later, additional therapy was given over the left sternoclavicular joint. The patient was examined in 1929 and found free of recurrence. The dryness in the mouth which had lasted for over a year had disappeared and the beard had also regrown.

E. A. POHLE, M.D., PH.D.

Results of Radiation Therapy of Uterine and Breast Carcinoma. Hermann Wintz. Strahlentherapie, 1929, XXXIII, 456.

In this statistical paper, Wintz relates the results of radiation therapy in uterine and breast carcinoma, in his clinic. Based on the analyzed cases, he presents his conclusions. The cure depends on the extent of the carcinoma, that is, whether it is localized and involves only the nearest glands, or is already generalized. The condition of the tumors and the surrounding tissue is also important (for

instance, inflammation and infection). Other factors are the dose and the type of application; the care before and after and the response of the organism as a whole.

E. A. POHLE, M.D., PH.D.

Primary Carcinoma of the Lung. James Alexander Miller and Oswald R. Jones. Am. Rev. Tuberc., January, 1930, XXI, 1.

This article deals only with carcinoma of the lung and is an exhaustive review of the literature for the last two decades, together with the authors' personal experiences in an intensive study of 32 definitely proven cases here presented for the first time. To those interested in the subject, the extensive bibliography will prove of great value and the historical review most interesting.

The incidence of carcinoma of the lung, according to the authors, compared to all other carcinomas, as gleaned from various sources, seems to be increasing. Most cases occur in males and 91 per cent occur in patients past thirty-five years of age. The opinion of all observers consulted seems to be that chronic irritation, such as bronchitis, inhalation of dust, etc., is a positive etiological factor, but not the sole cause.

In this study, three groups of the disease are considered: (1) carcinoma of the lining epithelium of the bronchi; (2) carcinoma of the mucous glands of the bronchi; (3) carcinoma arising from pulmonary alveoli. The first class seldom produces a massive tumor of the lung, but a more diffuse thickening of the walls and parenchyma. The second class results rapidly in a bronchial stenosis, with the usual accompanying symptoms. The third class produces diffuse or multiple nodular growths of varying size and distribution. The great majority of tumors of the lung are bronchial in origin. Metastasis is shown to occur most generally to the pleura, local lymph nodes, liver, kidneys, bones, but occasionally to any organ or tissue.

A detailed description of the clinical manifestations and an analysis of the symptoms are given. The physical signs are varied and not pathognomonic.

The evidence offered by the X-ray is the most valued single diagnostic sign. The examination of tissue obtained by bronchoscopic examination is sometimes positive. The authors advise such examination in all cases.

Ten types of the disease are enumerated, with detailed description of each, accompanied by diagrammatic cuts and roentgenograms. All known methods of treatment are shown to be of little value. A detailed history, the physical signs, X-ray and laboratory findings in 32 cases are given. The presentation shows an exhaustive study and will serve as valuable reference for those interested in any and all phases of the disease.

S. C. BARROW, M.D.

Further Contribution to the Effect of the Electric Current on Epithelium and Carcinoma Cells. E. Delbanco. Strahlentherapie, 1930, XXXV, 103.

The author discusses histological changes in carcinoma cells observed after the application of high frequency currents. They are illustrated in photomicrograms and consist essentially of an elongation of the carcinoma cells, very similar to the epithelial changes reported by Jellinek in skin, following an electric burn. It was interesting to note that in one case whose history is related, the cells of the metastasis show the same histological picture. The cells of the primary tumor had not been carried by the lymphatics but grown from the primary growth *per contiguum.*

E. A. POHLE, M.D., PH.D.

On the Results of Roentgen Therapy in Skin Carcinoma. G. Stümpke. Strahlentherapie, 1930, XXXV, 98.

The author reports his results obtained in the treatment of skin carcinoma during the last fifteen years. The first group (cancroids) shows nineteen definite cures out of a total of thirty-four patients. Twelve of these had only one single X-ray exposure. In the second group (deeper infiltrating skin carcinoma), ten cures out of a total of seventeen cases were observed. Here again, eight of these cases healed following one X-ray exposure. It is stated that the three recurrences observed in

the first and second groups had received very high doses. In the third and last group (lupus carcinoma), no cures were obtained. Ten cases out of a total of thirteen showed temporary improvement.

While it appears from the literature on the subject that radium seems to be preferable in certain cases, the author's observations demonstrate the efficacy of roentgen rays in the treatment of skin carcinoma. The importance of a careful technic, of the administration of a fairly high dose, and of the strict observance right anterior-posterior stereoscopic films and abscess localization.

E. A. POHLE, M.D., PH.D

The Treatment of Cancer. Herbert A. Bruce. Jour. Can. Med. Assn., May, 1929, XX, 469.

The writer gives the important facts brought before the International Congress of Cancer in London, in July, 1928. The general opinion as to colloidal lead was that it is a dangerous drug, and its use is not justified. Radium gives its best results in epitheliomata of epidermal origin, *e.g.*, epitheliomata of the skin, mouth, tongue, nasal fossæ, pharynx, vagina, and cervix uteri. In cases of the lip, tongue, and cervix uteri it is now conceded that a higher percentage of local cures can be secured by radium than by operation. Deep X-ray therapy receives scant courtesy from the pen of the author. Surgery plus radium he sees as the future hope for most cases of cancer. Further, radium should be in the hands of surgeons, and should be used exclusively by them.

L. J. CARTER, M.D.

Irradiation as a Means of Treating Cancer. Henry K. Pancoast. New Eng. Jour. Med., January 16, 1930, CCII, 103.

The legitimate measures used in the treatment of cancer at the present include surgery, irradiation by radium and X-ray, electrothermic methods, cauterization, caustics, and the internal administration of some heavy metals in colloidal state. In some instances all the various methods are carried out by the same individual; in others, they are administered by various members of a group or clinic. This paper stresses the application of irradiation in certain localities where there may be some difference of opinion and where special care in technic is required. In superficial malignancies certain factors, such as cosmetic effect, minimum loss of tissue, depth of lesion, danger to other structures, etc., govern the application of irradiation. Radium is the agent of choice in basal-cell carcinomas about the face. On the ear, radium is used with care and combined with electrodesiccation when involvement extends to cartilage. The same applies to the nose. Lesions on the lower lip are treated all alike, as if they were the most malignant form, combining electrocoagulation whenever there is induration below the mucous surface; the lymph drainage areas are thoroughly radiated with X-ray. Lesions in the mouth offer a great field for radiation, early lesions yielding readily, while late lesions and those in certain unfavorable localities give poor results. The larynx, esophagus, lung, stomach, large bowel, bladder, and prostate all are unfavorable locations for radiation treatment and little is to be expected from any method now used. In cancer of the breast, information, opinions, and technic are all very confusing, some excellent authorities reporting good results from combined treatment, others equally eminent claiming that radiation adds nothing to surgical results. There is need for a thorough study of the question of breast cancer.

W. W. WATKINS, M.D.

Generalized Abdominal Carcinomatosis of Ovarian Origin: Report of Three Cases Treated by Irradiated Autogenous Ascitic Fluid and Deep Roentgen Therapy. G. E. Pfahler and J. Gershon-Cohen. Am. Jour. Roentgenol. and Rad. Ther., November, 1929, XXII, 447.

Three patients with ovarian carcinomata, complicated by ascites, were treated by combined deep roentgen therapy over the abdomen, using the saturation method and injections of autogenous irradiated ascitic fluid. No

additional benefit could be detected over that obtained by deep roentgen therapy alone, in similar cases of general abdominal carcinomata.

J. E. HABBE, M.D.

The Importance of the Reticulo-endothelial Apparatus in the Roentgen Treatment of Carcinoma of the Cervix. H. Zacherl. Strahlentherapie, 1929, XXXIII, 515.

Experiments conducted on rabbits show that the function of the reticulo-endothelial system following irradiation of the body depends upon the applied dose. Saccharated oxide of iron is eliminated slower from the blood following exposure of the entire body of the animal to a large dose of roentgen rays as compared with the untreated control. A small dose seems to hasten the elimination of the injected substance from the blood. These results are not correlated with the leukocytosis because all animals showed definite leukopenia at the time of the injection. Similar results were obtained if the phagocytic function was tested by injecting bacteria. This increased function is said to be due to a stimulating effect of roentgen rays on the reticulo-endothelial cells. In patients suffering from carcinoma of the cervix, the reticulo-endothelial function was found to be decreased and was further decreased following roentgen irradiation. In treating malignant tumors, this fact must be duly considered.

E. A. POHLE, M.D., PH.D.

CATHODE RAYS

The Therapeutic Use of Cathode Rays. W. Baensch and R. Finsterbusch. Strahlentherapie, 1929, XXXIII, 399.

The authors have continued their experiments with cathode rays and report the results of their investigations dealing with the effect on plants, bacteria, animals, and patients. Ionization measurements have convinced them that at 4 to 5 cm. distance from the tube diaphragm about 93 or 89 per cent of the entire radiation are cathode rays. They contradict, therefore, the article by Schaefer and Witte, these authors stating that the majority of the rays emitted from the cathode tube are roentgen rays. The experiments on plants show a specific effect of cathode rays on plant tissue fundamentally different from that of roentgen rays. Insertion of a thin piece of cardboard prevents any effect of the cathode rays. It was possible to kill bacteria of all kinds with cathode rays at 5 cm. distance from the tube diaphragm (92 K.V., 2 ma.) in ten seconds. The ulcer produced by cathode rays on animal skin heals promptly, with a smooth scar, and is essentially different from the roentgen ulcer, which heals very poorly. Since the cathode rays affect only the surface, skin diseases in man were exclusively treated. Carcinoma of the skin, tuberculosis of the skin, psoriasis, chronic eczema, and slow healing wounds were treated. The results were encouraging, except in the case of infection and slow healing wounds. In closing, it is emphasized again that the reported results must be due to the effect of cathode rays and not to roentgen rays.

E. A. POHLE, M.D., PH.D.

THE CHEST

Functional Studies of the Tracheobronchial Tree with the Aid of the Cin-ex Camera. William A. Hudson and Hans A. Jarre. Brit. Jour. Radiol., November, 1929, II, 523.

The writers have devised a "Cin-ex Camera" for taking from one to four films per second of lipiodol-filled bronchi or other moving structures. The apparatus is so arranged that by a single turn of a crank the following cycle of events is completed: (1) two intensifying screens are clamped together by springs with a section of a band or roll of film between them; (2) an automatically timed X-ray exposure is made, with the part to be studied interposed between tube and film; (3) the screens are drawn apart, and the film is advanced a fixed distance for the next exposure. By serial studies during the various phases of respiration, a definite contraction wave synchronous with expiration is observed in the bronchi in normal individuals, which originates in the peripheral branches and advances in rhythmical fashion towards

the trachea. This normal peristaltic action may be greatly interfered with in cases of long standing bronchial infections and bronchiectasis, while in asthmatic cases the peristaltic mechanism becomes intensified to the point of preventing the opaque oil from entering the terminal bronchioles and alveoli.

J. E. HABBE, M.D.

Bronchial Obstruction: Its Relation to Atelectasis, Bronchopneumonia, and Lobar Pneumonia. A Roentgenographic, Experimental, and Clinical Study. Pol N. Coryllos and George L. Birnbaum. Am. Jour. Roentgenol. and Rad. Ther., November, 1929, XXII, 401.

The close relationship between atelectasis and all forms of penumonia is stressed, both as to causation, which the authors attribute to varying degrees of bronchial obstruction, and as to pathogenesis, which is shown by gross and microscopic studies of laboratory animals to be identical. Differences in symptoms, roentgenologic signs, and bronchoscopic findings are in degree only. With such similarities established, a plan of treatment for pneumonia, particularly the lobar type, similar to the commonly accepted method of treating cases of atelectasis (*i.e.*, bronchoscopic removal of obstructing plugs of mucus, or rolling the patient on the unaffected side and simultaneously provoking cough) is recommended as a more rational treatment than absolute immobilization.

J. E. HABBE, M.D.

Neoplasms of the Lung. William C. Von Glahn. Am. Rev. Tuberc., January, 1930, XXI, 57.

The writer calls attention to congenital cysts and gives a list of authors who have written on the subject and the cases reported. Cases of congenital adenoma, to the extent of five or six, all discovered in newborn infants, are recounted. Chondromata and osteomata are also listed among the benign tumors occurring in the lung. Sarcoma of the lung he considers as rare, refined histological study placing most instances of sarcoma in a class with carcinoma. Carcinoma constitutes the main and large class of lung neoplasms, occurring in proportion to all carcinomata as one to ten.

As to cause, a striking report is made by one observer that six cases of lung tumor were found in twenty-four rats that had had tar applied to the skin, while the inhalation of tar mixture was rarely followed by tumor. In the Philippine Islands, where incidence of tuberculosis is high, autopsy material shows carcinoma of the lungs to be rare. Chronic bronchitis, influenza, inhalation of dust and other irritants are cited as causative factors, but no convincing evidence is given. One author (Weller) cited, lays stress upon "intrinsic excitants."

Carcinoma arises from the bronchial epithelium and glands and alveoli. The latter produce the massive lobar tumor, while a new-growth arising in the bronchi gives the diffuse, irregular shadow to be seen jutting out from the hilum. Several case histories are given, showing the origin, X-ray and physical findings.

S. C. BARROW, M.D.

The Diagnosis and Treatment of Lung Abscess. Frank S. Dolley. Calif. and Western Med., January, 1930, XXXII, 28.

Under this subject and the sub-head of diagnostic aids the author states that, aside from the history, the most important diagnostic aids are fluoroscopy and X-ray films. Fluoroscopy should be done with the patient in the upright position if his condition possibly permits it. Films of the subject flat in bed are worse than useless: no fluid level can appear in this position, and the shadows are vague and indistinct, more suggestive of broncho- or lumbar pneumonia or empyema than of lung abscess. In the upright position a fluid level often appears, immediately simplifying the diagnosis. Under the fluoroscope, change of position in the presence of a fluid level enables one to shift the air bubble above the fluid in various directions, thus definitely outlining the limitations of the cavity. Upright anterior-posterior stereoscopic films and a single lateral one should always be taken,

for they are almost an indispensable aid in abscess localization.

Lipiodol to delineate the abscess cavity is a material help. Theoretically it would seem easy for the bronchoscopist to find the particular lobe bronchus from which pus is issuing, inject lipiodol, and at once demonstrate the abscess. However, this does not often occur. The instruments have narrow lumina, the oil is thick (considerable pressure must be exerted to inject it), and the portion of the lobe receiving the delineating oil becomes drowned. The fluoroscope reveals a rather solid wall of lipiodol, conforming neither to the bronchial tree nor to the supposed abscess cavity. It may or may not be the seat of the inflammatory process. Far more satisfactory is it for the bronchoscopist to inject the main right or left bronchus through a larger instrument without pressure, and allow the oil to gravitate into the various branches of the bronchial tree. It is seldom that oil is shown within the cavity itself, but often the surrounding uninvolved bronchi are splendidly disclosed, so that by elimination localization may be greatly furthered.

FRANCIS B. SHELDON, M.D.

Bronchiectasis: What the Use of Iodized Oil has Demonstrated Relative to Diagnosis by Ordinary Roentgen Examination. Adolph Hartung. Am. Jour. Roentgenol. and Rad. Ther., August, 1929, XXII, 120.

While about 60 per cent of all cases of bronchiectasis should be diagnosed by careful study of chest films of good quality, in the author's series of 92 positive cases only 20 cases (or a little over 20 per cent) gave sufficient information to allow of accurate diagnosis as to the presence and extent of the bronchiectases. In many instances the heart or diaphragm shadows or a generalized fibrosis of the lung prevented recognition and accurate localization of the pathology. Displacement of the heart to the affected side occurred in a little over one-third of all cases, while an increase in the linear markings in the lower lobes was the commonest finding on the plain film, this being observed in almost half of the cases.

J. E. HABBE, M.D.

Roentgen Irradiation in Unresolved Pneumonia. Edwin A. Merritt and Edgar M. McPeak. Am. Jour. Roentgenol. and Rad. Ther., January, 1930, XXIII, 45.

Seven cases in the nature of unresolved pneumonias or incompletely resolved ones were given relatively small doses of roentgen radiation over the affected portion of the chest through anterior and posterior portals, using 7 inch spark gap, 20 milliampere-minutes, 10 inch distance, 3 millimeters of aluminum. Four cases showed complete resolution within five to ten days of treatment, two cases were definitely improved, and one showed no response. Parenchymal consolidations clear more readily than hilum lesions. The authors recommend irradiation in cases showing signs of delayed resolution three weeks after onset of the acute lobar consolidation.

J. E. HABBE, M.D.

Observations on the Symptomatology and Pathology of Massive Collapse of the Lung. P. Benedetti. Paris Méd., November 9, 1929, XIX, 425. (Reprinted by permission from Brit. Med. Jour., January 11, 1929, No. 3,601, p. 7 of Epitome of Current Medical Literature.)

The author believes that massive collapse of the lung is much more frequent than was thought to be the case a few years ago. Etiologically it can be classified as post-traumatic; the sequel of some respiratory illness such as bronchitis, pulmonary abscess, or tuberculosis, and a complication of various conditions, including diphtherial paralysis of the diaphragm, acute poliomyelitis, HCl poisoning, acute meningitis, malaria, and costal fracture due to neoplasm. There is often a sudden onset, with dyspnea, cyanosis, pain and a sense of thoracic constriction, tachycardia, cough (often with expectoration), fever, and leukocytosis, but these symptoms may be absent and the condition only be detected by physical and X-ray examination.

Unless the condition is bilateral it is rarely fatal, and postmortem examination is seldom possible owing to the improvement or cure which almost invariably ensues.

The mechanical and nervous phenomena as-

sociated with the signs and symptoms of massive collapse are discussed, and six points are put forward in support of the view that there is a double antagonistic nerve supply to the lung. On the one hand, the parasympathetic influences the expansion of the lung by lengthening the interlobular and pleural muscle fibers, producing a dilatation or diastolic state of the lung; the sympathetic, on the other hand, determines the retraction by causing contraction of the muscles, producing a systolic state of the lung. The innervation of the pleuro-interlobular mechanism is thus the inverse of that of the muscular system of the bronchi. Physiological experiments on animals are also mentioned which support this view, and, in conclusion, the hypothesis of pulmonary tonicity as applied to cases of massive collapse is put forward to explain the pathology of this morbid condition.

DOSAGE

Is Accurate Dosage of Roentgen Rays Possible without Continuous Measuring? Paul Feldweg. Strahlentherapie, 1929, XXXIII, 574.

It appears that even in valve tube equipment, the output of the X-ray tube may change approximately 10 per cent, due to the aging of the kenetrons. The author feels that this fluctuation is too high to be ignored. He urges, therefore, that an ionization chamber be placed on the patient during the entire treatment.

E. A. Pohle, M.D., Ph.D.

On the Question of Dosage: The Application of Bucky Rays. W. Scholtz and J. Dörffel. Strahlentherapie, 1930, XXXV, 83.

The area which can be expressed homogeneously with the low voltage X-ray tube is small, although at 7½ cm. F.S.D., it has a diameter of approximately 10 centimeters. Only half the intensity is still present 3 cm. away from the central rays. This must be borne in mind in outlining the treatment of large skin areas. Since the output of different outfits and tubes varies considerably, each tube is calibrated by the author by first determining the erythema dose on human skin. A photographic method is used for the control of the dose. It consists essentially of the exposure of photographic paper which is then compared with a standardized scale. In a number of skin diseases, as, for instance, eczema, psoriasis, lichen, and others, favorable results were obtained.

E. A. Pohle, M.D., Ph.D.

Investigations Concerning the Dosage of Hard Roentgen Rays. Second Communication. Walter Fürst. Strahlentherapie, 1929, XXXIV, 340.

The author continues, in this second article (See *Strahlentherapie*, 1929, XXXIII, 601), the discussion of his observations concerning the influence of distance, intensity, radiation, and number of tubes used in the treatment, on the skin reactions. It appears, for instance, that for higher filtered radiation, 23 per cent had to be added to the calculated treatment time when changing from 30 cm. to 60 cm. F.S.D., in order to obtain the same degree of erythema. He concluded that the maximum dose for the skin does not coincide with that for the cervix, provided filtered radiation, long distances, two tubes (A and B) are used. As a rule, the maximum dose for the deeper tissues is lower than the corresponding value for the skin. The skin erythema can not be used, therefore, as an indicator for doses, particularly for a high dose of roentgen rays as given within the short time period. Before irradiation, a blood examination should be done to permit the intelligent study of the patient after the treatment.

E. A. Pohle, M.D., Ph.D.

Investigations Concerning the Dosage of Hard Roentgen Rays. Third Communication. Walter Fürst. Strahlentherapie, 1929, XXXIV, 501.

In this third and last article (see *Strahlentherapie*, 1929, XXXIII, 601; XXXIV, 340), Fürst discusses the dosage in r-units from a clinical standpoint and relates in detail the technical procedure followed in his laboratory.

The half value layer in copper has been given preference for indicating the quality of radiation. In numerous tables, the details of doses administered in a number of patients are given. The amount of back-scattering measured on a paraffin phantom is higher as compared with the measurements carried out on the patient. A very important conclusion is the statement that with higher filtered radiation, injuries in the deeper tissues can well be produced without an excessive skin reaction.

E. A. POHLE, M.D., PH.D.

Further Investigations on the Roentgen Radiation Emitted by the Lenard Tube. Walter Schaefer and Ernst Witte. Strahlentherapie, 1929, XXXIII, 578.

Additional data on depth doses of radiation emitted by a cathode-ray tube are presented. The authors intend to have a small cathode-ray tube constructed similar to the X-ray tube in order that it may be introduced into body cavities.

E. A. POHLE, M.D., PH.D.

EXPERIMENTAL STUDIES

On the Effect of Roentgen Treatment on the Basal Metabolism. Anna Jugenburg. Strahlentherapie, 1929, XXXIV, 288.

The effect of roentgen rays on the basal metabolic rate was studied in fifty-four guinea pigs. Twenty-four animals received total body irradiation with 375 r, eleven animals received 72 r; in the remaining animals only certain parts of the body were exposed (180 K.V., 0.5 Zn + 3.0 Al, 30 cm. F.S.D., 10 cm. x 15 cm. field). Guinea pigs which had received 375 r over the entire body usually died from fourteen to sixteen days after the exposure. Autopsy revealed pneumonia, pleuritis, pericarditis, and ulcer of the stomach. The following conclusions are presented:

(1) Roentgen irradiation produces changes in the basal metabolism of guinea pigs, depending upon the dose.

(2) General body irradiation (375 r) reduces the basal metabolic rate and also the oxidation processes, with a depression of the nitrogen metabolism and a retention of nitrogen in the organism. These changes develop so quickly that the animals die within from fourteen to sixteen days following irradiation.

(3) If smaller doses are given, the effect is much less and the basal metabolic rate returns to normal after three or four weeks; in some cases, there was even an increase of the oxidation processes. It is assumed that under the influence of the roentgen radiation with small doses, the respiratory quotient increases. This suggests an increase of the combustion of the carbohydrates. Irradiation of the abdominal region only of the guinea pig leads to a definite increase in weight and an increase in the basal metabolic rate, without very much influence upon the oxidation processes. Irradiation of the head and neck causes a loss in weight and a drop in the basal metabolic rate in some cases. However, no definite influence of the irradiation can be detected.

E. A. POHLE, M.D., PH.D.

Investigations on Roentgen Sensitization. First Communication: The Mechanism of the Sensitization of Iodine Salts. D. L. Rubinstein. Strahlentherapie, 1929, XXXIV, 414.

A number of investigators have attempted to sensitize the organism to roentgen rays by injecting solutions of salts with high atomic number. The author studied this problem on *Protozoa,* using a potassium or sodium iodine solution of from 0.15 per cent to 0.8 per cent. The radiation was produced at 210 K.V., 3.5 ma., and filtered only through two layers of cardboard. If the *Protozoa* are irradiated in water with a dose of 30,000 to 40,000 r, they do not show any definite signs of injury. If, however, the iodine salt is added, they die very quickly. Careful study of this effect revealed the fact that the potassium and sodium iodide decay under the influence of roentgen rays, liberating free iodine. The amount of liberated iodine depends mostly upon the amount of ozone found in the air and not so much upon the direct effect of roentgen rays on the iodine salt solution. If this free iodine was neutralized, for instance, by adding sodium hyposul-

phide, the sensitizing effect could not be produced. The author concludes, therefore, that the sensitizing action of iodine salts which has been attributed to an electronic emission or a secondary radiation is in reality due to a chemical change of the solution.

E. A. POHLE, M.D., PH.D.

Influence of the Quantum on the Biological Effect of Different Qualities of Roentgen Rays. R. Braun and H. Holthusen. Strahlentherapie, 1929, XXXIV, 707.

The study of this article demands more knowledge of physics and mathematics than the average radiologist can reasonably be expected to possess. However, the problem discussed by the authors is not only interesting but very important from a practical point of view. The recent literature dealing with the relation between quantum theory and X-ray injury curves, sometimes called "death curves," is critically discussed in comparison with the experiments of the writers. There were no systematic relations between the form of the death curve and the average sensibility of the biological object. No influence of the wave length on the death curve could be detected. Its distortion in experiments extending over a long period of time is undoubtedly due to the influence of the time factor. If fractional doses are given, a complete cumulation of their effects could be noticed if the experiments were carried out on *Ascaris* eggs under anaërobiosis.

E. A. POHLE, M.D., PH.D.

On the Influence of Roentgen Rays upon the Vegetative System. Gerhard Gabriel. Strahlentherapie, 1929, XXXIV, 813.

In order to study the effect of roentgen rays on the autonomic nervous system, the right neck of rabbits or the heart was irradiated. Technic: 220 K.V., 3 ma., 0.5 mm. Cu + 1.0 Al, 23 cm. F.S.D., half value layer in copper 0.8 mm., 1 E.D. = 620 r. The initial dose was sometimes doubled and then 310 or 155 r repeated at intervals of several days. Following a single dose of 620 r to the vagus and to the sympathetic nerves in the right neck, there was a temporary deviation of the electrocardiogram in the T and R waves. After repeated exposures, the vagus tonus appeared to be increased. If the heart had been exposed through the back, the results were essentially the same, but the changes did not disappear within twenty-four hours. No serious injuries could be seen during the period of observation.

E. A. POHLE, M.D., PH.D.

Variations in the Growth of Irradiated Bean Roots. Sylvia B. Wigoder and Ruth E. P. Patten. Brit. Jour. Radiol., December, 1929, II, 588.

Experiments were conducted on irradiation of bean roots, which structures are made up of a mass of rapidly growing and dividing cells, somewhat comparable to the tumor cells in the human. The Arndt-Schulz law stating that large doses of X-rays kill, medium doses paralyze, and small doses stimulate, was confirmed except that no stimulating effects resulted from small doses.

J. E. HABBE, M.D.

The Life Rays. Walter Stempell. Strahlentherapie, 1929, XXXIV, 868.

Gurwitsch discovered the so-called mitogenetic radiation, which is emitted by cells undergoing mitosis. They, in turn, stimulate the mitotic processes in other tissues. The author conducted experiments with onion roots by using the so-called Liesegang rings as detector. They are formed only under the influence of light. If the experiments were conducted in the dark room with ground onions, the rings appeared. The author believes, therefore, that there can be no doubt as to the existence of the mitogenetic radiation.

E. A. POHLE, M.D., PH.D.

GALL BLADDER (NORMAL AND PATHOLOGICAL)

The Intravenous Method of Cholecystography and Liver Function Test as Employed in Office Practice. Charles A. Wa-

ters and John H. King. Am. Jour. Roentgenol. and Rad. Ther., January, 1930, XXIII, 34.

The authors use 2.5 grams of sodium phenoltetraiodophthalein which is injected by the gravity method in 40 c.c. of freshly distilled water, sterile salt solution being injected first and after completing the dye injection to make certain that the needle is in the vein and to wash out what dye is in the needle before it is withdrawn. The entire injection requires only about fifteen minutes, after which the patient reclines on a couch for one-half hour. The procedure is a routine one for office examination and liver and gall-bladder function are determined from the single dye injection. Very dense shadows are obtained, which makes possible the radiographing of the filled gall bladder in oblique and lateral, as well as postero-anterior views. Only one case of venous thrombosis occurred in approximately one hundred injections.

J. E. HABBE, M.D.

New Methods for the Clinical Study of the Gall Bladder: An Elaboration of Cholecystography with Simultaneous Examination of the Stomach and Duodenum. George Levens and Lester R. Whitaker. New Eng. Jour. Med., Jan. 30, 1930, CCII, 203.

After discussing some of the reasons for unsatisfactory results with cholecystography, these authors describe their technic, which includes some unusual points. Among these are the combination of oral and intravenous administration of dye, aiming to diminish the reactions from each method; fluoroscopic examination of the visualized gall bladder in the resting gall bladder; definite fatty meal with barium, and the study of the stomach, duodenum, and motor action of the gall bladder under the fluoroscope. By this technic, they can determine the condition of the mucosa, as well as the muscularis; the presence of adhesions, as well as of stones; the presence of pathology as well as of disturbed function. The direct study of the motor response of the gall bladder to the fatty meal, which the authors insist should be standardized by the use of the fluoroscope, seems to the reviewer to be the most interesting phase of this work.

W. W. WATKINS, M.D.

Cholecystography. R. T. Wilson. Texas St. Jour. Med., February, 1930, XXV, 668.

The author uses chiefly the oral method. During the three-year period of 1926–1928, 2,112 examinations of the gall bladder have been made, representing 7.7 per cent of all X-ray examinations, as contrasted with 1.1 per cent (255 examinations) during the preceding five years. Of the 2,112 cases submitted to cholecystography, 53.5 per cent were classified as cholecystitis, and 5.1 per cent of these showed calculi. In a group of 201 operations, positive evidence of gall-bladder disease had been demonstrated by cholecystography, with oral administration of the dye in 75.5 per cent of the cases. No response, slight response, and irregular cholecystograms are evidences of diseased bladder and ducts. The strawberry gall bladder showed as abnormal to the dye test in 50 per cent of the operatively proven cases. In the discussion of this paper the opinions with regard to the oral and intravenous methods were evenly divided, with very positive statements as to the advantages of the two methods, by the respective proponents.

W. W. WATKINS, M.D.

GASTRO-INTESTINAL TRACT (DIAGNOSIS)

The Roentgen-ray Diagnosis of Lesions of the Small Intestine. Horace W. Soper. Am. Jour. Roentgenol. and Rad. Ther., August, 1929, XXII, 107.

For obtaining maximum information regarding small intestine lesions serial studies between the 2½ and 6 hour periods are recommended, in every instance the patient being studied in the vertical position. It is emphasized that findings of partial obstruction from any cause are not apt to be constant, but, rather, will be observed for a short time only. No mention of a special barium mixture is made, hence it is to be assumed that the customary barium-milk drink is given as for study of the stomach and duodenum.

Evidence of pathology in the jejunum or

ileum often manifests itself by barium-filled loops showing atypical outline and relationship. The differentiation between abdominal metastatic carcinoma and tuberculosis of the peritoneum is only possible by determining the presence or absence of a primary tumor. Pseudodiverticula produced by primary malignancy of the small bowel show greater irregularity of outline and remain filled with barium a shorter time than diverticula not associated with malignancy. Atypical patterns of the small bowel loops are common following appendectomy and other abdominal operations, and these do not necessarily indicate clinical pathology.

J. E. HABBE, M.D.

Intussusception — Its Roentgenographic Diagnosis: Report of Cases. Kenneth S. Davis and Carl Parker. Calif. and Western Med., November, 1929, XXXI, 330.

In intussusception with acute obstruction, an extensive X-ray examination is unnecessary and not to be advised. In chronic intussusception the roentgenographic findings vary, depending on the degree, permeability, and duration of the invagination, the amount of constriction, presence of edema, adhesions, etc. They are as follows:

(1) The barium enema early in the course of the affection leads to characteristic findings. There is a momentary obstruction to the flow of the barium, but by change in position, manipulation, and maintenance of pressure, the barium can be made to pass around the intussusception, leaving a central gas-filled defect.

(2) The barium enema after formation of adhesions leads to equally characteristic findings. There is then noted a complete obstruction to the flow of the barium, the head of the enema having a characteristic "U" or cupola shape, a filling defect not commonly observed in other obstructing lesions. The apex of the intussusceptum may contain gas.

(3) The motor meal study may show: (*a*) An apparent absence of one segment of the bowel—usually the cecum or ascending colon; (*b*) A thin tract of barium as it passes through the intussusceptum; (*c*) An annular filling defect at the neck of the intussusceptum.

FRANCIS B. SHELDON, M.D.

Chronic Duodenal Stasis. H. L. Bockus. Northwest Med., February, 1930, XXIX, 51.

Cases showing duodenal stasis may be divided into two broad groups: (1) intermittent occlusion due to pinching of the terminal duodenum by the mesentery, and (2) stasis dependent upon organic disease. The criteria for roentgen-ray diagnosis (Duval) are as follows: Dilatation of the proximal duodenum down to the midline; antiperistalsis and churning in the duodenum; disappearance of duodenal retention in the ventral position or by Hayes' maneuver. The stomach may or may not participate in the dilatation. In mesenteric occlusion the duodenum presents a large, wide shadow throughout the first three portions, there being an absence of the normal markings of the cap and valvulæ conniventes.

W. W. WATKINS, M.D.

Congenital Pyloric Stenosis in an Adult. Norman M. Guiou. Can. Med. Assn. Jour., January, 1930, XXII, 82.

A woman aged thirty-five, with a history of progressive vomiting, was found on X-ray examination to have almost complete pyloric obstruction. On operation the pylorus felt thick, and the pre-operative diagnosis of pyloric malignancy was considered correct. A partial gastrectomy was performed. On section of the resected pylorus no lesion was found. The condition was a stenosis of the congenital type. The further history (elicited post-operative) revealed that as a girl the patient had had cramps and vomiting after eating meat.

L. J. CARTER, M.D.

Carcinoma of the Duodenum: Report of Case. James S. Archibald. Ill. Med. Jour., January, 1930, LVII, 62.

The author reports a case of this relatively rare lesion, with autopsy findings. Carman is quoted to the effect that carcinoma of the duodenum is so rare that it should be thought of last of all. There is no characteristic X-ray sign of this lesion, but a closer study of carcinoma of the duodenum from the X-ray

standpoint will be valuable. The lesions presenting findings in some respects similar to those of duodenal carcinoma are pyloric stenosis from carcinoma, obstruction from pressure such as carcinoma of the pancreas, carcinoma of the gall bladder, adhesions causing obstruction, benign tumors, membranous stenosis, arteriomesenteric occlusion. The X-ray interpretation in the cited case was duodenal ulcer, cholecystitis, and cyst of head of pancreas; pathological diagnosis was adenocarcinoma of the duodenum, with metastases to liver and head of pancreas.

W. W. WATKINS, M.D.

Extrinsic Defects of the Gastro-intestinal Tract: Report of Cases. D. Y. Keith. Am. Jour. Roentgenol. and Rad. Ther., November, 1929, XXII, 455.

Three cases showing filling defects and displacement of the stomach or intestines, and diagnosed as tumors outside the gastro-intestinal tract, are described. One case showing a large pressure filling defect of the midportion of the greater curvature of the stomach proved, at operation, to have a large quantity of bile-stained fluid filling the lesser omental cavity and originating from a leak in the gall bladder which had been drained eleven years previously. The second case also had a fluid content in the lesser omental cavity displacing the stomach downward and to the left, and also displacing the splenic flexure directly downward. It had as its origin a ruptured malignant ulcer on the lesser curvature of the stomach. The third case occurred in a child of two years of age who, at operation, showed a hemorrhagic cyst of the greater omentum and who roentgenographically showed signs of fluid in the abdominal cavity and a constant pressure filling defect of the midportion of the transverse colon.

J. E. HABBE, M.D.

MEASUREMENT OF RADIATION

The Dependence of Air Ionization by Roentgen Rays, Alpha, Beta, and Gamma Rays of the Atmospheric Pressure. Hurbert Habs and Hans Küstner. Strahlentherapie, 1929, XXXIV, 823.

There is a definite relation between the ionization in the chamber of a dosimeter and the atmospheric pressure. The authors compared the expected variations as calculated by known physical laws with those found in actual tests. From their investigations, it must be concluded that aluminum chambers are not suitable for accurate measurements in r-units. The sensitivity controls of a dosimeter should be carried out with a radio-active substance acting upon the same ionization chamber which is exposed to roentgen rays.

E. A. POHLE, M.D., PH.D.

A New Principle in the Construction of Dosimeters. Robert Jaeger. Strahlentherapie, 1929, XXXIII, 542.

A dosimeter based on a constant source of current is described which may be regulated in linear relations. The electrometer is used in the circuit as null instrument (compensation method).

E. A. POHLE, M.D., PH.D.

On the Physics of the Thimble Ionization Chamber. Fourth Communication. R. Braun and H. Küstner. Strahlentherapie, 1929, XXXIII, 551.

In this fourth article on the physics of the thimble ionization chamber, the authors study the dependence of the wave length of a number of small chambers available on the market. They find that the new chamber attached to the Siemens Dosimeter and also the ionization chambers built by Glocker are most independent of the wave length.

E. A. POHLE, M.D., PH.D.

Principles of Roentgenotherapy. II.—Fundamentals of Dosimetry (continued). Ernst A. Pohle. Wisc. Med. Jour., February, 1930, XXIX, 80.

This second paper on dosimetry discusses the quantity of radiation. X-ray energy

may be measured directly, but this is a very difficult procedure, so that all methods in use are indirect methods, *i.e.*, the effect of the rays on a solution (chemical) or a gas (ionization) is recorded. The methods discussed are those of (1) Sabouraud and Noiré; (2) the Kienbock Unit (X); (3) Furstenau Unit (F); (4) the *e*-unit; (5) the skin unit; (6) the erythema dose; (7) International Unit. It would be advisable always to record the following data for each treatment: kilovoltage, tube current in ma., focal skin distance, size of field, diameter of part, filter, time, lambda effective, number of r-units per second or per minute, number of r-units administered, number of r-units chosen as toleration dose, depth dose percentage and body dose, if possible. These should also be stated in any paper reporting roentgen therapy, in order to permit intelligent interpretation.

W. W. Watkins, M.D.

The Present Status of X-ray Dosimetry with the Sabouraud-Noiré Tablet. H. Th. Schreus. Strahlentherapie, 1930, XXXV, 72.

A number of investigators have studied the relation between the dose measured by the Sabouraud-Noiré Tablet and the quality of radiation. They all agree that the dependence of the wave length has its maximum in the range of the unfiltered or slightly filtered radiation. However, if the dose for 10 X was expressed in r-units and then plotted against the quality of radiation (half value layer in copper), the curves of the various investigators would have nearly the same slope but differ a good deal quantitatively. This discrepancy remains still unexplained. Investigations of his own seem to show that the number of r-units required for identical erythema reactions increase with decreasing average wave length. This was studied with radiation produced at 120 K.V., unfiltered, or filtered through 1 mm. to 3 mm. Al (half value layer in copper 0.025–0.165 mm.). It is suggested that the manufacturers furnish calibrated tablets which would permit a correction for the wave length dependence. In addition to that, the development of a simple and inexpensive but reliable instrument to measure the quality of radiation in practice is required. Tables are appended giving the sufficient dose as measured by the Sabouraud-Noiré method in superficial therapy.

E. A. Pohle, M.D., Ph.D.

The Importance of the r-unit for the Measurement of the Dose of Gamma Rays of Radium. Otto Glasser and F. R. Mautz. Strahlentherapie, 1929, XXXIV, 845.

A dosimeter suitable for the measuring of the gamma rays of radium in r-units is briefly described. Tables and curves give the doses obtained with different radium preparations, different ionization chambers, different filters, at various distances. The authors found that 2,000 r represent a mean value for a skin erythema dose if gamma rays of radium are used.

E. A. Pohle, M.D., Ph.D.

A Critique of the Cadmium Cell. Franz Linke. Strahlentherapie, 1930, XXXV, 62.

The properties of the cadmium photo-electric cell and its shortcomings are discussed from the standpoint of the physicist. In the author's opinion, the weakest point is the fact that the photo-electric currents measured through the cell are not proportional to the intensity of the short ultra-violet radiation if the source of light varies in its spectral composition. The measuring of the direct sunlight intensity is impossible because of the variable amount of sky radiation which is part of the total radiation recorded by the cell. Similar objections are voiced from the standpoint of the biologist. Several remedies for this condition are suggested. It is concluded that caution should be exercised in the interpretation of all results obtained by this method.

E. A. Pohle, M.D., Ph.D.

Actual Problems of Biological Dosimetry in X-ray Deep Therapy. Hans Holfelder. Strahlentherapie, 1930, XXXV, 54.

The developments of the various treatment methods in X-ray deep therapy are discussed, with a critical comparison of the single massive dose, the fractional dose, and the saturation dose method. The possibility of combining roentgen treatment with other measures, for instance, dextrose injections or inhalations of CO_2, should be studied more thoroughly. Progress in radiation therapy in the future is possible only by extensive biologic research and international co-operation of all radiologists and cancer research workers.

E. A. POHLE, M.D., PH.D.

MEDICAL PRACTICE

Radiology and the General Practitioner. Ignatius J. Murphy. Journal-Lancet, Feb. 15, 1930, L, 88.

This author discusses a number of lesions which are usually seen by the general practitioner, and which should be treated by radiation, either by the practitioner himself or by a radiologist. He finds many practitioners using X-ray without insurance protection, and thinks the clause attached to the usual insurance policy excluding X-ray therapy is unjust and uncalled for. The use of the fluoroscope for fracture work is of more danger to the patient than the administration of superficial therapy for skin lesions.

W. W. WATKINS, M.D.

Present Status of Radiology. J. M. Martin. Southern Med. Jour., February, 1930, XXIII, 138.

Because of the general application of radiology, the specialist in this branch must qualify himself for its application to the various departments of medicine and surgery, which means that he must have sufficient knowledge of all branches of medicine to make this application intelligently and satisfactorily. He must, therefore, be a thoroughly trained physician, working as a consultant, giving an opinion and judgment based on his findings, and must be able to correlate and compare these with the clinical history. The value of this opinion will depend on the thoroughness of his training and the degree of care which he gives to the study of a case, and not upon the material or even time used in making the examination. A novice may use twenty-five dollars' worth of material and much time, and then not be able to give an opinion of value to the clinician for whom he is acting as consultant. Any one of the various methods of securing X-ray service, without consideration of these fundamentals, will be a "cheap shortcut," manifestly unjust to the patient.

W. W. WATKINS, M.D.

ROENTGEN THERAPY

Relief of Projectile Vomiting in Infants by Radiation of the Upper Chest Region. Orville Barbour and J. W. Connell. Ill. Med. Jour., February, 1930, LVII, 110.

In 43 cases of true clinical projectile vomiting, treatment was as follows: 30 per cent were treated with atropine and thick feeding, 20 per cent with phenol-barbital, 45 per cent by upper chest radiation, and 5 per cent by surgery. The writers used radiation after noting that one of their cases had a large thymus, and decided to radiate the thymus before giving an anesthetic for a Rammstedt operation. The patient stopped vomiting 12 hours after X-ray treatment. The authors give clinical histories of a number of their cases. The X-ray technic is the same as that for thymic dyspnea. They suggest as an etiologic factor toxic irritation from lymphoid hyperplasia, and imply that radiation removes this toxic factor by the destruction of the excess of lymphoid tissue. Projectile vomiting was relieved in 21 cases by radiation of upper chest area. Of the 21 cases, (1) five were permanently relieved by one exposure of X-ray; (2) three were permanently relieved by one application of radium; (3) twelve received temporary relief by X-ray treatment and perma-

nent relief by radium; (4) one case was treated by the X-ray without relief, but received temporary relief from a Rammstedt operation, and three months later was permanently relieved by the use of radium.

C. H. DeWitt, M.D.

The Radiotherapy of the Suprarenals in a Case of Addison's Disease, Markedly Improved by Radiation. L. Popp. Röntgenpraxis, February, 1930, II, 128.

The author reviews the literature on the effect of radiation of the suprarenal glands, and comes to the conclusion that the results of experimental work and clinical studies are not uniform, and that there must be an individual difference of radiosensibility as far as the adrenals are concerned. He treated a rather severe case of Addison's disease with radiation over the suprarenals (75 per cent H.E.D. with high voltage rays). After only a few days there was a definite subjective improvement. The pigmentation of the skin was lessened and the vomiting stopped. After four weeks the same amount of radiation was given. Ten weeks after the first radiation there was only very slight pigmentation. On first admission the blood pressure was 102/82; after treatment it was 120/100. The patient felt much stronger, and he had gained three kilograms. Adrenalin had been given hypodermically twice daily before radiation, with little improvement. The good result lasted four months, when the patient suddenly died. Because a hyperplastic thymus had been suspected during fluoroscopy of the chest the thymus might, in the author's opinion, have been the cause of the sudden death. He, therefore, suggests combining radiation of the adrenals with radiation of the thymus.

H. W. Hefke, M.D.

On the Roentgen Therapy of Basedow's Disease. Alexander Lorey. Deutsche med. Wchnschr., Feb. 14, 1930, LVI, 259.

Following a brief discussion of the present status of Basedow's disease, Lorey reports four cases with very severe symptoms. One patient had a B.M.R. of 86 per cent. All responded well to roentgen irradiation. Most of his other cases were operated on after they had received from about 400 r to 600 r, in fractional doses at four-week intervals. He regrets that the majority of radiologists have no hospital beds of their own where they can observe their patients properly. The patients are usually referred for treatment only by other clinics, and whatever is done to each case in addition to irradiation is learned by the radiologist very often only by accident. Frequently the patients do not return for treatment, and upon inquiry, it appears that they have been either discharged or operated on. He recommends in severe cases, 50 r per treatment every two or three days until a total of from 600 r to 700 r has been given. There should then follow an interval of two months. Lorey believes that radiation should be given a trial in every case of Basedow's disease where social conditions do not interfere. If, after four months, there is no response, operation is indicated. Whether or not radium therapy will be of benefit in cases in which roentgen therapy has failed, must be further investigated.

E. A. Pohle, M.D., Ph.D.

X-ray Injury in a Child Following Epilation of the Scalp with Heavily Filtered Roentgen Rays, and its Medico-legal Side. R. Habermann. Strahlentherapie, 1930, XXXV, 123.

A boy three years of age was treated for eczema of the scalp. On July 16, 1925, he received 25 per cent E.D. through 0.5 Zn., 50 cm. F.S.D., for 2 minutes and 24 seconds. August 6, the eczema was worse; the lesions looked now more like mycosis. Therefore, on August 20, total epilation was carried out in seven fields, giving each field one-third E.D., through 0.05 Zn., 30 cm. F.S.D., 4 minutes per field. On September 3, there was complete epilation; fourteen days afterwards an erythema of the first degree appeared; on the sixteenth day, the skin of the entire scalp appeared inflamed; the child had high tempera-

tures, and there was evidence of erysipelas. Scratch wounds could be seen in several places on the scalp. During the next few weeks the temperature dropped, the erysipelas healed, with desquamation of the entire scalp. During the following few months, the skin regenerated slowly under moist dressings and exposure to the quartz mercury vapor lamp. In January, 1926, only an area of silver-dollar size was not completely covered by epithelium. The child was not returned after July, 1926, for further observation. The parents consulted another physician, who diagnosed an X-ray injury and the case reached the courts promptly. In March, 1927, the major part of the scalp was epilated, the skin was thin, of a bluish-white color, with areas of pigmentation and a penny-size ulcer in the parietal region. In October, 1928, the findings were essentially the same but there was no ulceration visible. However, there was a crust about the size of a fifty-cent piece in the right frontal region. Two expert witnesses agreed as to the presence of a typical X-ray reaction of the third degree. They emphasized that all precautions had been taken during the treatment because the dose had been determined with a Wulf Ionometer, and, in addition to that, with a Fürstenau Intensimeter. The treatment had been carried out by an experienced nurse with nine years' X-ray service, under the direction of a recognized radiologist. They did not believe, therefore, that there was any negligence involved. The author criticizes these statements, taking exception to the indefinite diagnosis and to the heavy filter used in the treatment, which is unnecessary for an epilation. He argues that it might even be contra-indicated to use so much penetrating radiation in a young individual. The late appearance of the injury fits in well with the usual reaction of the skin if exposed to roentgen rays of short wave length.

E. A. Pohle, M.D., Ph.D.

The Advantages of X-ray Treatment for Venereal Buboes. E. Klopfer. Röntgenpraxis, January, 1930, II, 93.

While formerly the treatment of venereal buboes has been entirely surgical, we have now in the roentgen rays a therapeutic agent by which it is possible to shorten the time of treatment, to lessen the extent of the surgical procedure considerably, and to abort breaking down of the buboes, if treated early enough. Ninety-four patients have been given roentgen therapy according to Heidenhain and Fried's method. The success of this treatment has been entirely satisfactory and it is highly recommended by the author.

H. W. Hefke, M.D.

THE THYMUS

Enlarged Thymus in the New-born. Arthur C. Singleton. Can. Med. Assn. Jour., January, 1930, XXII, 23.

In a series of 95 apparently normal newborn infants, 35 per cent showed enlarged thymus shadows on the X-ray film. The size fixed for the maximum width of the normal thymus shadow is 3.5 cm. All children showing thymic symptoms should receive the benefit of radium or X-ray treatment, even though no enlargement of the thymus shadow is seen on the X-ray film . When there is an enlarged thymus shadow the X-ray treatment produces a marked diminution in size. It also causes marked disappearance of thymic symptoms. The technic for the X-ray treatment used was: 90 K.V., 10 in. focal skin distance, 5 ma., 5 min., 3 mm. Al filtration—the equivalent of one-half an erythema dose. This was given weekly for four doses, exposing front and back of chest alternately.

L. J. Carter, M.D.

The Use of X-ray in the Treatment and Diagnosis of Enlarged Thymus. Samuel W. Donaldson and John M. Barnes. Jour. Mich. St. Med. Soc., January, 1930, XXIX, 29.

The treatment of thymus enlargement by radiation is a very satisfactory procedure. True enlargement, with or without symptoms, responds to relatively small doses. The authors use only a single anterior field of application. The younger the child, the more

readily the enlargement yields to radiation. The most marked decrease becomes evident within a week or ten days following one or two treatments. Three age groups are distinguished: early infancy, the tonsil and adenoid age, and the third decade. They regard a shadow distinct from the great vessels and causing the mediastinal density to be more than 60 per cent of the chest diameter at the level of the second rib as abnormal. Radiation is given the first group at 24 to 72 hour intervals for three or four treatments, about 30 r of filtered radiation each time; in the second group about 60 r at weekly intervals, and a somewhat larger dose for the third group.

W. W. WATKINS, M.D.

TUBERCULOSIS

Comparative Radiographic and Anatomical Studies of Intestinal Tuberculosis. M. Maxim Steinbach. Am. Rev. Tuberc., January, 1930, XXI, 77.

The author reviews various reports from different writers on the subject and details a report on 67 cases studied clinically, roentgenologically, and at autopsy, showing a roentgenological error in 52 per cent. In the course of his article, he quotes Brown and Sampson, who report 106 cases studied in similar manner, with a roentgenological error of minus 2 per cent. The obvious conclusion can only be that some one and not the method is at fault.

Interesting facts showing the frequency of intestinal tuberculosis associated with pulmonary tuberculosis are cited. Of the 127 cases studied by him, only 38.6 per cent were diagnosed during the life of the patient, and the clinical history gave no indication of the presence of the disease in 61.4 per cent. Other writers are quoted as clinically in error in 68 per cent.

The article is well worth reading, but carries no conviction because of the contradiction of equally experienced observers.

S. C. BARROW, M.D.

The Value of the X-ray Examination in Pulmonary Tuberculosis. Leo G. Rigler. Minn. Med., January, 1930, XIII, 25.

The technic of the X-ray examination of the lungs is of the first importance, as it is dangerously easy to obtain findings simulating early tuberculosis or to obliterate signs as the result of poor technic. The roentgenogram presents a fairly accurate picture of the pathology in the lungs. The absence of abnormal changes is the best and most conclusive evidence against pulmonary tuberculosis that we now have. In most cases the X-ray signs are present before the physical signs become apparent, and the presence of typical roentgen findings is positive evidence second only in certainty to finding tubercle bacilli in the sputum. It must not be forgotten, however, that abnormal findings may be due to many lesions other than tuberculosis, such as atypical bronchopneumonia, pulmonary congestion, acute bronchitis, chronic bronchitis and bronchiectasis, chronic or unresolved pneumonia, and chronic lung fibrosis. In many cases the roentgen appearances will suggest activity or inactivity, though this cannot be said to be the rule. Also, the appearances may indicate whether the lesion is exudative or proliferative. Cavities and miliary tuberculosis are much more definitely shown by X-ray than by physical signs.

W. W. WATKINS, M.D.

The Heliotherapy of Tuberculosis of the Lungs and Pleura. P. Roussel. Strahlentherapie, 1929, XXXIV, 665.

In this paper which the author presented before the International Congress on Light, in 1928, the history, as well as the physical, physiological, and therapeutic foundations of heliotherapy are related first. Then follows a discussion of the relation between climate and heliotherapy, a description of the technic of the writer, with statistical studies, and a comparison of the literature on the subject. His own indications in the various tuberculous infections and the clinical results are also set forth. It is concluded that heliotherapy is a valuable therapeutic aid in the treatment of

tuberculosis of the lungs. Its effect is always both local and systemic, with a preponderance of the systemic action. Heliotherapy can be carried out almost anywhere, but is, as a rule, more favorable on the seacoast and in the mountains. There is no danger in this therapy if administered in moderate doses and used only in selected and well suited cases. Excellent results are usually seen in the fibrous type of tuberculosis of the lungs, in tuberculosis of the mediastinal glands, and in pleural disease. In interstitial tuberculosis, the results are less striking. Tuberculosis in the acute stage should not be treated by heliotherapy. It often supports the healing action of an artificial pneumothorax. Prophylactic heliotherapy in children, particularly during the latent stage of the infection, is strongly recommended.

E. A. POHLE, M.D., PH.D.

A New Method of Treating Lung Tuberculosis with Vitamin D. H. Menschel. Strahlentherapie, 1929, XXXIV, 655.

Fifty-five patients with tuberculosis of the lungs were observed over a period of one year. They received Vitamin D in the form of a preparation called "Vigantol." The results were very encouraging. High doses caused nausea, leukocytosis, anorexia, and loss of weight. In the writer's experience, the best dose was from two to five drops of a 1 per cent Vigantol oil.

E. A. POHLE, M.D., PH.D.

The Treatment of Tuberculosis of the Mucous Membranes with Artificial Sunlight. Emil Wessely. Strahlentherapie, 1929, XXXIV, 798.

The increase of tuberculosis of the larynx in Vienna induced the author to construct a lamp whose spectrum imitated that of the mountain sun, both as to quality and quantity. A carbon arc lamp was developed which emitted radiation down to 2,900 Å., with 120,000 Hefner candles per square centimeter as compared with 90,000 to 150,000 Hefner candles per square centimeter in the sun. By interposing a water filter, the infra-red rays were absorbed in order to prevent excessive heating of the tissues. The clinical results were excellent. Cases of tuberculosis in the larynx and in the mucous membrane of the mouth are illustrated before and after treatment. Sensibilization by intravenous injection of from 2 to 3 c.c. of trypaflavine is also recommended.

E. A. POHLE, M.D., PH.D.